FACILITY DESIGN AND OPERATION
TABLE OF CONTENTS

SECTION TITLE PAGE NO.

FACILITY DESIGN AND OPERATION
TABLE OF CONTENTS

SECTION **TITLE** **PAGE NO.**

FACILITY DESIGN AND OPERATION
TABLE OF CONTENTS

SECTION	TITLE	PAGE NO.

FACILITY DESIGN AND OPERATION
LIST OF FIGURES

FACILITY DESIGN AND OPERATION
LIST OF FIGURES

FACILITY DESIGN AND OPERATION
LIST OF TABLES

TABLE **TITLE** **PAGE NO.**

FACILITY DESIGN AND OPERATION

This Chapter provides an overview of (1) the design of the WIPP facility and associated principal structures, systems, and components (SSCs), and (2) the waste handling/emplacement process. Sufficient detail is provided to facilitate hazard identification and principal design and safety criteria selection.

As discussed in the General Plant Design Description[1] (GPDD), no Design Class I SSC exists at the WIPP. Design information is provided in this chapter only for those SSCs listed in Table 4.1-1 that have been designated as Design Class II, and IIIA in the GPDD. Design Class IIIB SSCs are briefly described only to the extent necessary to complete the overview of the facility design and operation. Detailed design information on each SSC may be found in the respective System Design Description (SDD).

4.1 Summary Description

The WIPP facility is located in Eddy County about 26 miles east of Carlsbad, New Mexico, encompassing 10,240 acres (16 sections) within the site boundary (Figure 4.1-1).

The controlled zones and associated fenced-in areas are described in Chapter 2. The facility is divided into three basic groups: surface structures, shafts, and subsurface structures, shown on Figures 4.1-2a, 4.1-2b, and 4.1-3.

The WIPP facility surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the underground. The surface structures are located in an area (approximately 35 acres) within a perimeter security fence (Figure 4.1-2a). WIPP surface traffic flow is shown in Figure 4.1-2a.

The vertical shafts extending from the surface to the underground horizon are the waste shaft, the salt handling (SH) shaft, the exhaust shaft, and the air intake shaft (AIS). These shafts are lined from the shaft collar to the top of the salt formation (about 850 ft [259 m] below the surface), and are unlined through the salt formation. The shaft lining is designed to withstand the full piezometric water pressure associated with any water-bearing formation encountered.

The subsurface structures consist of the waste disposal area, the support area, and the experimental area (Figure 4.1-3). The experimental area was deactivated in September 1996.

References for Section 4.1

1. U.S. Department of Energy, Waste Isolation Pilot Plant, General Plant System Design Description (GPDD), Revision 2, April 1997.

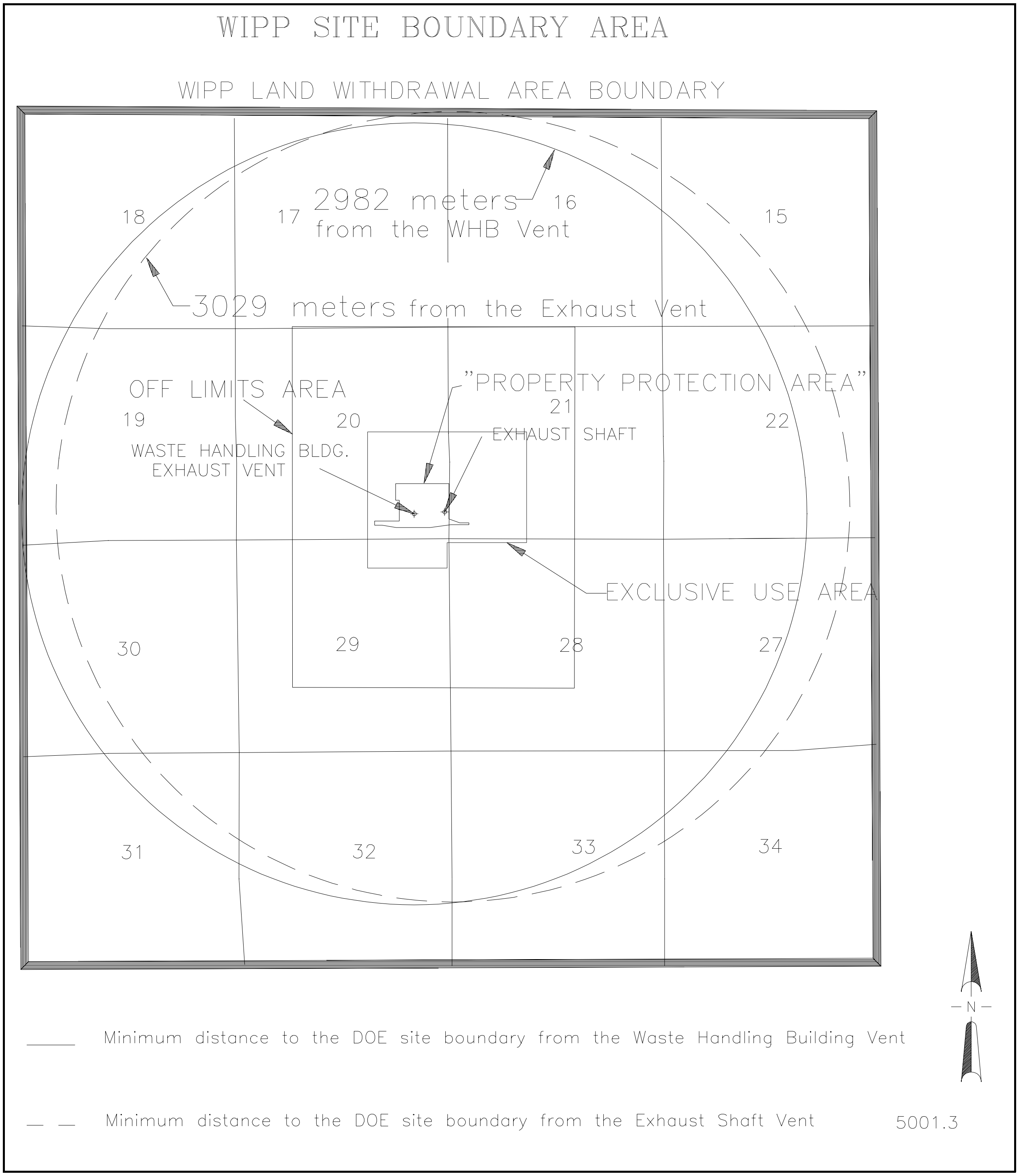

Figure 4.1-1, WIPP Site Boundary and Subdivisions

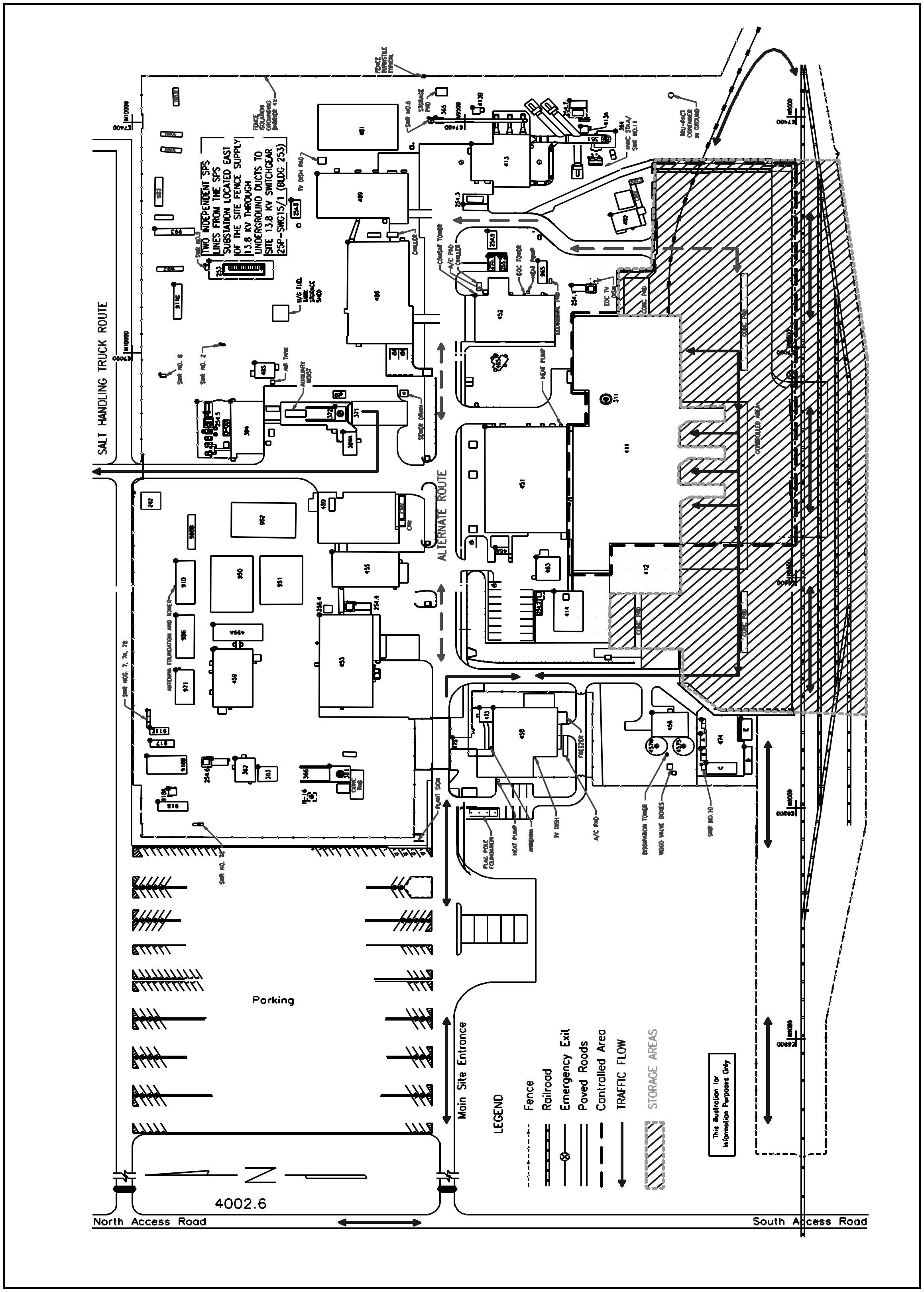

Figure 4.1-2a, WIPP Surface Structures

BLDG./ FAC. #	DESCRIPTION
242	NORTH GATEHOUSE
253	13.8 KV SWITCHGEAR 25P-SWG15/1
254.1	AREA SUBSTATION NO.1 25P-SW15.1
254.2	AREA SUBSTATION NO.2 25P-SW15.2
254.3	AREA SUBSTATION NO.3 25P-SW15.3
254.4	AREA SUBSTATION NO.4 25P-SW15.4
254.5	AREA SUBSTATION NO.5 25P-SW15.5
254.6	AREA SUBSTATION NO.6 25P-SW15.6
254.7	AREA SUBSTATION NO.7 25P-SW15.7
254.8	AREA SUBSTATION NO.8 25P-SW15.8
254.9	AREA SUBSTATION NO.9 25P-SW15.9
255.1	BACKUP GENERATOR #1 25-PE 503
255.2	BACKUP GENERATOR #2 25-PE 504
311	WASTE SHAFT
351	EXHAUST SHAFT
361	AIR INTAKE SHAFT
362	AIR INTAKE SHAFT/HOIST HOUSE
363	AIR INTAKE SHAFT/WINCH HOUSE
364	EFFLUENT MONITORING INSTRUMENT SHED A
365	EFFLUENT MONITORING INSTRUMENT SHED B
366	AIR INTAKE SHAFT HEADFRAME
371	SALT HANDLING SHAFT
372	SALT HANDLING SHAFT HEADFRAME
384	SALT HANDLING SHAFT HOISTHOUSE
384A	SALT HOIST OPERATIONS
411	WASTE HANDLING BUILDING
412	TRUPACT MAINTENANCE FACILITY
413	EXHAUST FILTER BUILDING
413A	EFFLUENT MONITORING ROOM A
413B	EFFLUENT MONITORING ROOM B
414	WATER CHILLER FACILITY & BLDG
451	SUPPORT BUILDING
452	SAFETY & EMERGENCY SERVICES FACILITY
453	WAREHOUSE/SHOPS BUILDING
455	AUXILLIARY WAREHOUSE BUILDING
456	WATER PUMPHOUSE

BLDG./ FAC. #	DESCRIPTION
457N	WATER TANK 25-D-001A
457S	WATER TANK 25-D-001B
458	GUARD AND SECURITY BUILDING
459	CORE STORAGE BUILDING
459A	SANDIA ANNEX
463	COMPRESSOR BUILDING
465	AUXILIARY AIR INTAKE
468	TELEPHONE HUT
473	ARMORY BUILDING
474	HAZARDOUS WASTE STORAGE FACILITY
474A	HAZARDOUS WASTE STORAGE BUILDING
474B	HAZARDOUS WASTE STORAGE BUILDING
474C	OIL & GREASE STORAGE BUILDING
474D	GAS BOTTLE STORAGE BUILDING
474E	HAZARD MATERIAL STORAGE BUILDING
474F	WASTE OIL RETAINER
475	GATEHOUSE
480	VEHICLE FUEL STATION
481	AUXILIARY WAREHOUSE
482	EXHAUST SHAFT HOIST EQUIP. WAREHOUSE
485	COMPRESSOR BUILDING
486	ENGINEERING BUILDING
489	TRAINING BUILDING
H-16	SANDIA TEST WELL (NOT IDENTIFIED)
908B	HBS TRAILER
910	ENVIRONMENTAL MONITORING TRAILER
911G	SANDIA OFFICES TRAILER

BLDG./ FAC. #	DESCRIPTION
917	AIS MONITORING
918	VOC TRAILER
918A	VOC AIR MONITORING STATION
918B	VOC LAB TRAILER
950	WORK CONTROL TRAILER
951	PROCUREMENT / PURCHASING
952	TRAILER (7-PLEX)
965	SAMPLE PREPARATION LAB
971	HUMAN RESOURCES TRAILER
982	TRAILER
986	PUBLICATIONS & PROCEDURES TRAILER
992	SANDIA CALIBRATION LAB TRAILER
993	SANDIA OFFICES TRAILER
SWR NO.1	SWITCHRACK NO. 1
SWR NO.2	SWITCHRACK NO. 2
SWR NO.3	SWITCHRACK NO. 3
SWR NO.6	SWITCHRACK NO. 6
SWR NO.7,7A,7B	SWITCHRACK NO. 7, 7A, 7B
SWR NO.7C	SWITCHRACK NO. 7C
SWR NO.8	SWITCHRACK NO. 8
SWR NO.9	SWITCHRACK NO. 9
SWR NO.10	SWITCHRACK NO. 10
SWR NO.11	SWITCHRACK NO. 11

4003.8

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Figure 4.1-2b, Legend for Figure 4.1-2a

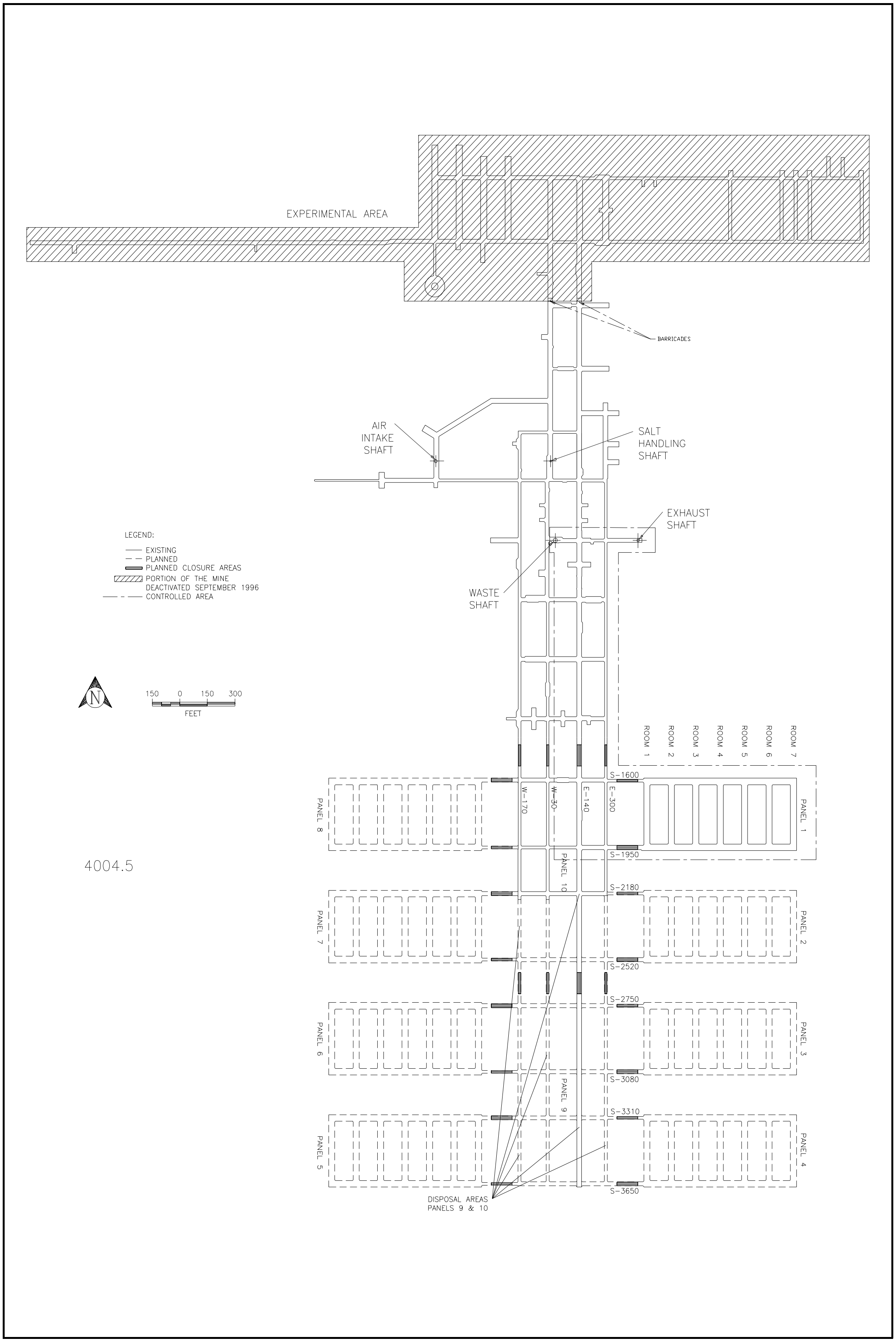

Figure 4.1-3, Planned Disposal Horizon

Table 4.1-1, Design Classes of Structures, Systems, and Components at the WIPP Facility **Page 1 of 5**

System/Component	Design Class (Note 1)	Seismic/Tornado Design Requirements	Design Class Function
COMPRESSED AIR SYSTEM (SDD-CAOO)			
High Efficiency Particulate Air (HEPA) filters for Support Building compressors	II		Control of radioactive effluent from entering the compressed air system
PLANT BUILDINGS, FACILITIES, AND MISCELLANEOUS EQUIPMENT (SDD-CFOO)			
Waste Handling Building structure and structural components including tornado doors (Bldg. 411)	II	Design Basis Earthquake (DBE), Design Basis Tornado (DBT)	Provide physical confinement
Auxiliary Air Intake Shaft and Tunnel (Bldg 465)	II	DBE, DBT	Failure could prevent mitigation
Station A Effluent Monitoring Instrument Shed (Bldg 364)	II	DBE, DBT	Design Class Interface. (Houses Station A)
Effluent Monitoring Rooms A and B (Building 413A and 413B)	II	DBE, DBT	Design Class Interface. (Houses Local Processing Units (LPU)s collecting data from Stations A and B)
Station B Effluent Monitoring Instrument Shed (Bldg 365)	IIIA	Uniform Building Code (UBC)	Design Class Interface. (Houses monitoring equipment for Exhaust Filter Building duct)
Support Building (Bldg 451)	IIIA	UBC (Note 2)	Design Class Interface. (Houses Central Monitoring Room (CMR)
Exhaust Filter Building (Bldg 413)	IIIA	UBC	Design Class Interface. (Houses Exhaust Filtration System)
EFB HEPA Filter Units & Isolation Dampers	II		Failure could prevent mitigation
EFB Exhaust System	IIIA		Failure could prevent mitigation
Building 412 (Originally TRUPACT Maintenance Facility)	IIIA	UBC (Note 2)	Design Class Interface. (Structural interface with WHB)

Table 4.1-1, Design Classes of Structures, Systems, and Components at the WIPP Facility **Page 2 of 5**

System/Component	Design Class (Note 1)	Seismic/Tornado Design Requirements	Design Class Function
PLANT MONITORING AND COMMUNICATION SYSTEM (SDD-CMOO)			
Central Monitoring System	IIIA		Monitors important facility parameters
ELECTRICAL SYSTEM (SDD-EDOO {Surface and Underground})			
Diesel Generator and associated equipment	IIIA		Provides backup power to Design Class II and IIIA items
ENVIRONMENTAL MONITORING SYSTEM (SDD-EM00)			
Volatile Organic Compound (VOC) Monitoring Equipment and sub-systems	IIIA		Monitors release of VOCs
HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEM (SDD-HV00)			
Exhaust Filtration System	II		Design Class Interface. (Control of radioactive effluent)
HEPA Filters	II		Control of radioactive effluent
Tornado Dampers	II	DBE, DBT	Control of radioactive effluent
Exhaust Systems HV01 (Bldg 411, CH HVAC), HV02, (Bldg 411, RH HVAC), and HV04 (Station A and Bldg 413, Exhaust Filter Building HVAC)	IIIA		Design Class Interface. (Provide filtration and maintain differential pressure)
HVAC for the CMR	IIIA		Design Class Interface. (Maintains acceptable CMR environment)

Table 4.1-1, Design Classes of Structures, Systems, and Components at the WIPP Facility **Page 3 of 5**

System/Component	Design Class (Note 1)	Seismic/Tornado Design Requirements	Design Class Function
RADIATION MONITORING SYSTEM (SDD-RM00)			
Stations A3, B2 and C (including the UPSs)	II	DBE, DBT	Monitors radioactive effluents
The remainder of the RMS SSCs (except PV00 equipment which is IIIB) are Design Class IIIA	IIIA		Monitors radioactive effluents
UNDERGROUND HOIST SYSTEM (SDD-UH00)			
Waste Hoist and Equipment	IIIA	(Note 3)	Failure could cause radioactive material release
UNDERGROUND VENTILATION SYSTEM (SDD-VU00)			
Exhaust duct elbow at the top of the Exhaust Shaft	II	DBE, DBT	Design Class Interface. (Channels exhaust air to the EFB)
HEPA Filters and Isolation Dampers	II		Control of radioactive effluent
Exhaust Fans for the filtration mode	II		Design Class Interface. (Channels exhaust air through the EFB)
Exhaust System Instruments and Hardware	IIIA		Design Class Interface. (Supports Exhaust Filtration System)
(6) High Pressure Fans for Bulkhead 309 (Pressure Chamber)	IIIA		Maintain buffer zone between RMA and non-RMA
WASTE HANDLING EQUIPMENT (SDD-WH00)			
6-ton TRUDOCK cranes	IIIA	DBE	Failure could cause radioactive materials release
Adjustable Center-of-Gravity Lift Fixtures (ACGLF's)	IIIA		Failure could cause radioactive materials release
TRUPACT-II tools	IIIA	(Note 6)	Failure could cause radioactive materials release
Leak check tools for TRUPACT-II	IIIA	(Note 6)	Failure could cause radioactive materials release
TRUPACT-II Lift Fixture (Non ACGLF)	IIIA		Failure could cause radioactive materials release

Table 4.1-1, Design Classes of Structures, Systems, and Components at the WIPP Facility **Page 4 of 5**

System/Component	Design Class (Note 1)	Seismic/Tornado Design Requirements	Design Class Function
Strongback Lifting Fixture (CH)	IIIA		Failure could cause radioactive materials release
SWB Lift Fixture Adapter	IIIA		Failure could cause radioactive materials release
TDOP Lift Fixture Adaptor	IIIA		Failure could cause radioactive materials release
SWB forklift Lift Fixture	IIIA		Failure could cause radioactive materials release
TRUDOCK Vent Hood System	IIIA		Failure could prevent mitigation
Facility Cask	II	(Note 4)	Provides permanent shielding
Telescoping Port Shield	II	UBC (Note 5)	Provides permanent shielding
Shield Bell	II	(Note 5)	Provides permanent shielding
Shield Valve	II	(Note 5)	Provides permanent shielding
Hot Cell Viewing Windows	II	(Note 5)	Provides permanent shielding
Transfer Drawer	II	UBC (Note 5)	Design Class Interface. (Provides permanent shielding)
140/25 ton crane	IIIA	UBC (Note 7)	Failure could cause radioactive materials release
Cask Lifting Yoke	IIIA		Failure could cause radioactive materials release
Facility Cask Loading Room Hoist	IIIA		Failure could cause radioactive materials release
Facility Grapples	IIIA		Failure could cause radioactive materials release
The Horizontal Emplacement and Retrieval Equipment (HERE)	IIIA		Failure could cause radioactive materials release
Hot Cell 15-ton Bridge Crane Bridge Mounted Manipulator PAR 6000	IIIA IIIA	(Note 7) (Note 8)	Failure could cause radioactive materials release Failure could cause radioactive materials release
Master-Slave Manipulator	IIIA		Failure could cause radioactive materials release

Table 4.1-1, Design Classes of Structures, Systems, and Components at the WIPP Facility **Page 5 of 5**

System/Component	Design Class (Note 1)	Seismic/Tornado Design Requirements	Design Class Function
Overpack Welder Equipment	IIIA		Failure could cause radioactive materials release
Grapple Rotating Block	IIIA		Failure could cause radioactive materials release
Canister Shuttle Car	IIIA		Failure could cause radioactive materials release

Notes

Note 1 See Table 3.1-2 for Basic Design Requirement and Table 3.2-3 for the Design Loads.
Note 2 The main lateral force resisting members of the Support Building and Building 412 are designed for DBE and DBT to protect the Waste Handling Building from their structural failure.
Note 3 Design loads and requirements dictated by Mine Safety and Health Administration (MSHA).
Note 4 Cask certification requirements exceed DBT/DBE.
Note 5 System completely within a Class II confinement - DBE/DBT not required.
Note 6 TRUPACT-II Design included in Safety Analysis Report for Packaging (SARP).
Note 7 Designed to hold load in place in the event of a DBE.
Note 8 Supports designed to prevent manipulator from falling during DBE.

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4.2 Facility Design

4.2.1 Surface Structures

WIPP's structures provide for the handling and subsequent underground emplacement of Transuranic (TRU) waste. Surface waste handling operations are conducted within a controlled area (CA). The normal extent of the CA for simultaneous contact handled (CH) and remote handled (RH) waste handling activities is depicted in Figure 4.1-2a. Operational Health Physics (OHP) will determine specific boundary locations and posting requirements for CAs, as required by scheduled waste handling activities and radiological conditions inside the Waste Handling Building (WHB). The CA external to the WHB provides for the receipt, storage, and dispatch of rail- or truck-transported radioactive waste shipping containers. OHP will determine specific boundary locations and posting requirements for the external CA consistent with scheduled activities.

The TRUPACT-II CH TRU shipping containers are removed from their transporters outside of the WHB prior to transfer into the WHB. RH TRU waste shipments, including the transporter trailer and shielded road cask shipping containers, are transferred into the WHB for subsequent operations.

The land areas around the surface buildings are designed to minimize erosion. Runoff water is diverted as necessary from the buildings, tracks, or roads and returned to the natural drainage path.

The WIPP facility does not lie within a 100-year floodplain. There are no major surface-water bodies within 5 mi (8 km) of the site, and the nearest river, the Pecos River, is approximately 12 mi (19.3 km) away. The general ground elevation in the vicinity of the surface facilities (approximately 3,400 ft [1,036 m] above mean sea level) is about 500 ft (152 m) above the riverbed, and 400 ft (122 m) above the 100-year floodplain. Protection from flooding or ponding caused by probable maximum precipitation (PMP) events is provided by the diversion of water away from the WIPP facility by a system of peripheral interceptor diversions. Additionally, grade elevations of roads and surface facilities are designed so that storm water will not collect on the site under the most severe conditions. Repository shafts are elevated at least 6 inches (15.2 cm) to prevent surface water from entering the shafts. The floor levels of all surface facilities are above the levels for local flooding due to PMP events.

The WIPP site is regulated by a National Pollutant Discharge Elimination System (NPDES) Storm Water General Permit. Facilities at the WIPP site have been constructed to contain or control storm water discharges; these include retention basins and storm water diversion berms. The site water tanks (two 180,000 gal [681354 L]) are located at the southwest corner of the property protection area, the topography of the site includes a sloping terrain to this corner of the site. There is a catch basin to the west of the water tanks, which is designed with adequate capacity (approximately 4.5 acres; approximately .25 acre/ft depth for failure of both tanks) to hold runoff from a failure of the water tanks.

4.2.1.1 Waste Handling Building

The WHB and its associated systems provide a facility to unload TRU waste from the incoming shipping containers and to transfer the TRU waste to the underground disposal area via the waste shaft. The WHB is divided into the following functional areas: the CH TRU waste handling area, the RH waste handling area, the WHB support area, Building 412, and the WHB mechanical equipment room. The general layout of the building is shown in Figure 4.2-1a and Figure 4.2-1b, with sectional views shown in Figure 4.2-3. Details of the hot cell area are given in Figure 4.2-4a, Figure 4.2-4b, and Figure 4.2-4c.

The WHB is a steel frame structure with insulated steel siding, and includes portions of the building, such as the hot cell complex, that are constructed of concrete for shielding and structural purposes. The WHB acts as a confinement barrier to control the potential for release of radioactive material and is classified as Design Class II. The WHB is designed for Design Class II loads, including the Design Basis Earthquake (DBE) and Design Basis Tornado (DBT). Waste handling areas subject to potential for contamination are provided with impermeable protective coatings. The WHB Confinement/Ventilation System is discussed in detail in Section 4.4, the Safety Support Systems in Section 4.5, and the Utility/Auxiliary Systems in Section 4.6.

4.2.1.1.1 CH TRU Waste Handling Area

The CH TRU side of the WHB has space and equipment for the unloading of TRUPACT-II shipping containers and enables the transfer of facility pallets and waste containers to the waste hoist for transfer underground. Waste transport routes to the WHB are shown in Figure 4.2-2. This area has air locks, CH Bay, and an unassigned area.

Entrance Air Locks

TRUPACT-II shipping containers are unloaded from the transport trailers in the CA external to the WHB and are transferred into the CH Bay area through the three air locks that provide access to the CH TRU side of the WHB. The WHB ventilation system maintains the interior of the WHB at a pressure lower than the ambient atmosphere to ensure air flows into the WHB, preventing the inadvertent release of airborne hazardous or radioactive materials. To assist the HVAC in maintaining the building at a negative pressure, the doors at each end of the air lock are interlocked to prevent inadvertent opening of both doors at the same time and thereby increasing CH Bay pressure.

CH Bay

The CH Bay on the CH TRU side of the WHB is used for surface CH TRU waste handling operations. To accommodate the TRUPACT-II shipping containers, the WHB is equipped with two TRUDOCKS (Design Class IIIB) and two overhead cranes for opening and unloading the TRUPACT-II shipping containers (Figure 4.2-5). Each TRUDOCK is designed to accommodate up to two TRUPACT-IIs. The TRUDOCK functions as a work platform, providing easy access to the TRUPACT for unloading.

The CH Bay also provides space for transferring loaded facility pallets to the waste hoist via forklifts, a shielded holding area, a waste handling equipment battery recharge area, and temporary storage areas for waste containers.

Storage locations are provided within the CH Bay for equipment, facility pallets, and TRUPACT-II drum pallets. Temporary waste storage within the WHB is discussed in Section 4.3. The shielded holding area may provide for surface holding of CH TRU waste containers during operational interruptions. The shielded holding area can accommodate one facility pallet load (i.e., 4 SWBs, 2 TDOPs, 28 drums, or combinations of all three).

TRUDOCK 6 TON CRANE

Each TRUDOCK is serviced by a 6 ton overhead crane that is used to transfer the TRUPACT-II outer containment vessel (OCV) and inner containment vessel (ICV) lids to their individual support stands, and the payload waste containers to the facility pallet. The cranes are Design Class IIIA and are identical having a single girder, underhung bridge, trolley, and wire rope hoist (Figure 4.2-6).

Each crane is controlled by its individual pendant control. The TRUDOCK crane is designed to hold its load in place in the event of a DBE or loss of power. Overhead cranes used in waste handling operations are certified to lift their rated capacity, and load tested to 125 percent of maximum rated lift. The crane control system allows the operator to lift and transfer the load by manual control or by use of an automatic, programmed control system which first lifts the waste assemblies vertically off the TRUDOCK via the shortest route horizontally to the location of the pallet. The cranes use specially designed lifting and load balancing fixtures, adjustable center-of-gravity lift fixture (ACGLF), SWB lifting assembly, TDOP lifting assembly and short and long lifting leg sets. The ACGLF also includes three electrical actuator motors and arms to rotate the lifting legs into their locking lift positions. The control system has limit switches with lights to indicate that each lifting leg has rotated to attach to the lifting pins. The following are the crane's motor ratings:

Drive	Horse Power	RPM	Operating Speed (FPM)	Travel
Hoist	7	1800	20	20 ft (6.1 m)
Trolley	½	1800	50	26 ft (7.9 m)
Bridge	1	1800	50	47 ft 4 in (14.4 m)

TRUDOCK Exhaust System

Each TRUDOCK has an exhaust system with two working stations, and each station consists of two sub-systems: (1) the TRUDOCK Vent Hood System (TVHS) (Design Class IIIA), and (2) the TRUDOCK Vacuum System . Both sub-systems are routed through industrial grade HEPA filters before entering the CH Bay exhaust system (which is also HEPA filtered before discharging to the atmosphere). (See Figures 4.2-7 and 4.2-8).

The TVHS consists of an enclosure which is installed over the TRUPACT-II ICV lid and the TRUPACT-II body before the lid is removed. The enclosure is connected to the exhaust system before the lid is removed, thus ensuring that any potential radioactive contamination will be passed through a system industrial grade HEPA filter.

The TRUDOCK Vacuum System is used to evacuate the TRUPACT-II OCV or ICV to pull the outer or inner lid down to assist in lid removal. The vacuum system inlet is connected by flexible tubing, using quick disconnect fittings, to the appropriate TRUPACT-II ICV or OCV vent port tool. A radiation assessment filter in the inlet line is used when evacuating the TRUPACT-II ICV. This process also discharges into the WHB controlled exhaust system.

Adjustable Center-of-Gravity Lift Fixture

The ACGLF (Design Class IIIA) is used with a TRUDOCK crane to lift the OCV and ICV lids, an empty ICV, or the payload waste containers out of the TRUPACT-II. The ACGLF has a lift capacity of 10,000 lb (4,542 kg) and weighs approximately 2,500 lb (1134 kg) (Figure 4.2-9). The ACGLF is designed as follows:

- The lower strongback assembly (carbon steel lifting beam structure) has three revolving joints, 120 degrees apart, to which the lifting legs are attached.

- Three linear actuators mounted on the underside of the lower strongback, provide the linear motion for each of the lifting leg revolving mechanisms which connect the lifting legs to the load.

- Two rotating weights to balance the load to be lifted are mounted on a circular upper plate assembly. The rotating weights are attached to two counter-rotating ring gears which are independently driven by gear motors.

- Two 1/4 HP, 115 Vac, single phase gear motors drive the counter-rotating ring gears that position the rotating weights around the circumference of the upper plate assembly.

- Three short lifting legs lift the OCV and ICV lids, empty ICV, or SWBs (when lifted with an SWB lift fixture adapter), and three long lifting legs lift a 14 drum pay load pallet. The bottom of the lifting legs are designed to engage a horizontal lifting bar in the lifting pockets of the OCV and ICV lids, SWB lift fixture adapter, and drum shipping pallet when the lifting leg is rotated into position.

- Two tilt sensors provide X and Y axis tilt indication of the ACGLF.

- Two balance weight position sensors continuously provide the position of each of the two rotating weights.

- A single point lifting shackle is mounted in the center of the ACGLF for attachment to the crane.

- One control console (portable with 4 wheels) provides operator controls and indicators to monitor the balance condition of the load, and to compensate, if necessary, for load imbalance by repositioning the two counter weights.

Non-adjustable Center of Gravity Lift Fixture

This fixture (Design Class IIIA) is similar to the ACGLF in function except it has no capability for balancing the load. It can be used as a backup for the ACGLF, if no ACGLF is available, to lift the TRUPACT-II OCV and ICV lids, entire ICV, and payload waste containers (pallet with 14 drums, or 2 SWBs strapped together). The fixture has a lift capacity of 10,000 lb (4,536 kg), and a weight of 600 lb (272 kg).

SWB Lift Fixture Adapter

The SWB lift fixture adapter (Design Class IIIA) frame is made from 6 in (15.24 cm) square steel tubing with a 3/16 in (0.48 cm) wall thickness. The center base is 56.44 in (143.4 cm) long, with a lift pocket for the ACGLF at one end, and a latch assembly at the other end. Two arms extend from the center bar near the lift pocket end to support two additional latch assemblies, each located 18 in (45.72 cm) from the center line of the center bar. Two slightly longer arms extend from the center base, near the opposite end, and provide two additional lift pockets. The three lift pockets are located on a circle of 56 in (142.24 cm) diameter to match the positioning of the three legs of the ACGLF. The SWB lift fixture adapter has a rated lifting capacity of 7,500 lb (3,402 kg) and weighs 334 lb (151.5 kg) (Figure 4.2-10).

TDOP Lift Fixture Adaptor

The TDOP lift fixture adaptor (Design Class IIIA) is made from 6 in (15.24 cm) square steel tubing with a 3/13 in (0.48 cm) wall thickness and is reinforced with a 7 gauge steel plate. It consists of three legs spaced 120 degrees apart with a latch assembly on the end of each leg. The latch hinge center lines are located on a 35 in (88.9 cm) radius from the center of the assembly. In-board from the latches are sections of schedule 80 pipe welded vertically to the assembly tubing in which holes are drilled horizontally and cold rolled steel pins are welded in place. These lift pockets are located on a circle of 56 in (142.2 cm) in diameter to match the positioning of the three legs of the ACGLF. The latch assemblies, which mate with the three lifting clips on the TDOP, are engaged with the latch handles, and are locked in place with ball lock pins. The TDOP lift fixture adaptor has a rated lifting capacity of 7,000 lb (3175 kg) and weighs 300 lb (136 kg) (Figure 4.2-28).

TDOP Upender

An upender is provided to support the recovery of a damaged SWB. The overpack container for an SWB is a TDOP. The TDOP must be laid horizontally to allow a forklift to insert the SWB. The TDOP must then be returned to the vertical position to allow installation of the TDOP lid. The TDOP upender provides a rotation of 90 degrees through the use of a mechanical chain and double reduction gear driven by an electrical motor.

The upender has a rated maximum capacity of 8,000 lbs (3628 kg) and a gross weight of 5920 lbs (2685 kg). Based on commercial industrial equipment commonly used to rotate large rolls of sheet metal or paper, the upender has been modified with a table sized to accommodate the TDOP. The table has a urethane coated Vee block and tie down straps to prevent a TDOP from rolling while being transported on the upender. The upender is bolted to a CH Facility Pallet prior to use to provide for stability and to allow transporting with a 13 ton forklift on the surface, an Underground Transporter, or the 20 ton forklift underground.

An amber warning beacon and horn mounted on the control enclosure activates 5 to 10 seconds prior to movement of the cradle. End of travel limit switches automatically stop the cradle in either the full up or down positions. Overtravel limit switches and hard mechanical stops prevent the cradle from rotating significantly beyond the full up or full down positions.

WHB Forklifts

There are two heavy-duty industrial 13 ton forklift trucks (Design Class IIIB). These forklift trucks are used to unload the TRUPACT-IIs from their transportation trailers (or rail cars), and move them through the WHB airlocks to support stands located in the pockets of the TRUDOCKS in the CH bay of the WHB. They are also used to move and transfer facility pallets, with or without a load of waste containers, between the CH bay and the conveyance loading car. Each of the 13 ton forklift trucks have a maximum lift height of 96 in (2.5 m). The forklift trucks' drive units use dc motors which are battery powered. The forklift trucks can operate for eight hours before the batteries have to be recharged. Each forklift truck has a high volume pump unit that supplies the fluid power for lift, tilt, and sideshift of the forks. A separate hydraulic power unit supplies fluid power for braking and steering.

Battery powered 6 ton capacity forklifts are available for use in both the WHB and underground. Diesel powered 6 ton capacity forklifts are available for use underground. The electric forklifts are equipped with push/pull attachments to handle waste containers. The diesel forklifts have push/pull attachments which can handle both waste containers and backfill super sacks. A 4 ton capacity diesel powered forklift with push/pull attachment is available and is capable of emplacing backfill super sacks on top of the waste stacks.

There is one 6 ton forklift truck (Design Class IIIB) in the CH bay of the WHB. It has a hydraulically operated side-shift positioner for shifting the load to the right or left. Either standard type forks or specially designed fixtures can be attached to the positioner for lifting different loads. The forklift truck is a standard battery powered forklift truck with a maximum lift height of 118 in (3 m).

The 6 ton forklift truck can operate for 8 hours before requiring a recharge of the batteries. It can be operated with different attachments as listed below:

- A BRUDI push/pull rack fixture with a drum handler to lift and move seven-packs of waste containers (drums).
- A single or double drum handling device.
- An SWB forklift fixture to lift and move individual SWBs.
- Two forks for lifting loads

Brudi Attachment

The Brudi attachment (Design Class IIIB) replaces the forks on the front carriage of a 6 ton forklift, and is used to handle waste containers on slipsheets (Figure 4.2-11). In normal operation, the Brudi attachment grips the edge of the slip sheet and draws the slipsheet and waste containers onto the platen for transport. When the destination is reached, the platen is positioned at the proper height, the gripper releases the slipsheet, and the linkage pushes the slip sheet and the waste containers into position.

SWB Forklift Fixture (forklifts)

One SWB forklift fixture (Design Class IIIA) is provided in the CH bay area of the WHB to lift and move SWBs with a 6 ton battery powered forklift truck. The SWB forklift fixture is basically a welded steel frame designed to be mounted and supported on the front side of a 6 ton forklift truck carriage from which the lifting forks have been removed. The fixture is a lifting accessory with a rated load lifting capacity of 4,000 lb (1,815 kg) designed specifically for lifting SWBs, and weighs 360 lb (163 kg) (Figure 4.2-12).

Facility Pallets

Facility pallets (Figure 4.2-13), (Design Class IIIB) are fabricated steel units designed to support drums, 85-gallon (321 L) overpacks, Ten-Drum Overpacks (TDOPs), or Standard Waste Boxes (SWBs), and have a rated load of 25,000 lb (11,340 kg). The facility pallets are designed with approximately 3 in (76 mm) deep pockets in the top plate of the pallet to accommodate two sets of two-high 7-packs, two stacks of two-high SWBs, two sets of two-high 4-packs of 85-gal (321 L) drums, or two TDOPs. Stacks of waste containers are secured to the facility pallet prior to transfer. Waste containers are separated by a slipsheet and a reinforcement plate, as required. Operations involving facility pallets are discussed in Section 4.3. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. A WIPP facility pallet can accommodate the contents of two TRUPACT-IIs. Since the maximum TRUPACT-II load is 7,265 lb (3,295 kg), the maximum weight of a loaded facility pallet is less than 19,000 lb (8,618 kg), including the pallet weight.

The Conveyance Loading Room

When a loaded facility pallet is ready to be transferred to the underground, a 13 ton forklift will transport the pallet to the conveyance loading room adjacent to the waste hoist. There the facility pallet will be loaded on the conveyance loading car in preparation for transfer to the waste hoist (Figure 4.2-1a). The conveyance loading room serves as an air lock between the CH Bay and the waste hoist shaft, preventing excessive airflow between these two areas. With the waste hoist materials platform properly positioned and prepared, the conveyance loading car will move onto the waste hoist conveyance on rails. There the facility pallet will be transferred to the waste hoist, and the conveyance loading car will be returned to the conveyance loading room.

The Conveyance Loading Car

The conveyance loading car (Design Class IIIB) is an electric vehicle that operates on rails. It is designed with a flat bed that has adjustable height capability, and will be used to transfer the facility pallets on or off the pallet support stands in the waste hoist conveyance by raising and lowering the bed (Figure 4.2.14).

<u>Waste Containers</u>

CH TRU waste containers will be equipped with filter vents. The filter vents allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations, and preventing the escape of any radioactive particulates. Each container is equipped with carbon-composite filters.

Standard 55-Gallon Drums

The standard 55-gallon metal drum (Figure 4.2-15) is a Department of Transportation (DOT) Type 7A (Authorized Type A package) or equivalent, steel fabricated drum with a maximum gross weight of 1,000 lb (453.5 kg), and is constructed with a lap welded bottom and numerous lid configurations. A standard 55-gallon drum has a gross internal volume of 208 L. 55-gallon drums may be used to collect site derived waste.

Standard Waste Box (SWB)

The SWB (see Figure 4.2-16) is a DOT Type 7A (Authorized Type A package) or equivalent, steel fabricated box with a lap welded bottom, and an internally flanged bolted closure lid. The weight of an empty SWB is approximately 680 lb (308.4 kg), and the maximum gross weight of a loaded SWB is 4,000 lb (1814 kg). Four threaded couplings (two on each side of the SWB with the lifting clips) are installed in the flange for inserting a filter to provide protection from particulate leakage during shipment or build-up of internal pressure. A minimum of two filters are required on each SWB. A SWB has an internal volume of 489 gallons (1880 L).SWBs may be used to collect site derived waste.

Eighty-Five Gallon Drum Overpack

The 85-gallon (321L) drum is a DOT Type 7A (Authorized Type A package) or equivalent, steel fabricated drum. The 85-gallon (321 L) drum overpack, which is shown in Figure 4.2-17, will be used primarily for overpacking contaminated 55-gal (208 L) drums at the WIPP facility. 85-gallon (321 L) drums may be used to collect site derived waste.

Ten-Drum Overpack (TDOP)

The TDOP is a metal container, similar to a SWB, that meets DOT Type 7A (Authorized Type A package) or equivalent, and is certified to be noncombustible. The TDOP is a welded-steel, right circular cylinder, approximately 74 in (1.9 m) high and 71 in (1.8 m) in diameter (Figure 4.2-18). An unloaded TDOP weighs approximately 1,600 lbs (725.8 kg) The maximum loaded weight of a TDOP is 6,700 lb (3,039.1 kg). The TDOP has an internal volume of 1162-gal (4400 L). A bolted lid on one end is removable, sealing is accomplished by clamping a neoprene gasket between the lid and the body. Filter ports are located near the top of the TDOP. A TDOP may contain up to ten standard 55-gal (208 L) drums or one SWB. TDOPs may be used to overpack drums or SWBs containing CH TRU mixed waste.

Pipe Overpack

The pipe overpack consists of a stainless steel pipe component surrounded by cane fiberboard and plywood dunnage within a standard 55-gallon (208 L) drum with a rigid polyethylene liner and lid. The pipe container provides three significant control functions with regard to waste materials: (1) criticality control, (2) shielding, and (3) containment of waste material.

The pipe component is a stainless steel, cylindrical pipe of 1/4-inch (0.64 cm) nominal thickness, with a closed bottom cap and a bolted stainless steel lid sealed with a butyl rubber O-ring (Figure 4.2-27a and 4.2-27b). The pipe component is approximately 2 ft (61 cm) long, and is available with either a 6-inch (15.24 cm) or a 12-inch (30.48 cm) diameter. The pipe component shall be vented through a filter. The pipe component is centered in the standard 55-gallon (208 L) vented steel drum with cane fiberboard and plywood packing material.

The pipe component and pipe overpack weights are as follows:

Size	Pipe Component Maximum Content Weight lbs. (kg)	Pipe Component Maximum Gross Weight lbs. (Kg)	Pipe Overpack Maximum Gross Weight lbs. (Kg)
6-inch (15.24 cm) diameter pipe component	66 lbs. (29.9 kg)	153 lbs. (69.4 kg)	328 lbs. (148.8 kg)
12-inch (30.48 cm) diameter pipe component	225 lbs. (102 kg)	407 lbs. (184.6 kg)	547 lbs. (248.1 kg)

Material content forms authorized for transport in the pipe component are as follows:

Form No.	Description
1	Direct load: Solids, any particle size; e.g., fine powder or organic particulate
2	Direct load: Solids, large particle size; e.g., sand, concrete, or debris
3	Direct load: Large, solid objects; e.g., metal cans containing waste

4.2.1.1.2 RH TRU Waste Handling Area

The RH side of the WHB includes structures and equipment for the unloading of shielded road cask shipping containers containing RH TRU waste canisters, and transferring the canisters of RH TRU waste from the shielded road cask to a shielded facility cask via the hot cell. The major areas within the RH waste handling area are shown in Figure 4.2-1a and Figure 4.2-1b.

RH Bay

The RH Bay on the RH side of the WHB provides a cask receiving area, preparation area, maintenance station and handling equipment for RH TRU waste shielded road cask shipping containers. A 140-ton bridge crane with a 25-ton auxiliary hoist is also provided in this area for lifting the shielded road cask, and is designed to stay on its rails retaining control of the load during a DBE.

Shielded Road Cask Receiving Area

The shielded road cask receiving area provides space to unload RH shielded road casks from incoming truck or rail transporters, and to load empty shielded road casks on outgoing transporters. The overhead bridge crane is designed to lift a shielded road cask from the transporter, and to position the shielded road cask on the road cask transfer car located at the road cask preparation station. The road cask receiving area also provides lay down space for shielded road cask tie-downs, impact limiters, and other components that must be removed as part of the shielded road cask unloading operation.

Road Cask Preparation Area

The road cask preparation area provides a tracked transfer car that travels between the road cask preparation area and the road cask unloading room portion of the hot cell complex. The transfer car supports the shielded road cask, and incorporates an integral work platform, providing personnel access to the head area of the shielded road cask. Shielded road cask preparatory operations in this area include: radiological surveys, controlled venting of the shielded road cask cavities, removing the outer closure, unbolting of the inner closure, and installing a shielded road cask seal collar for mating with the seal ring in the road cask unloading room. The road cask transfer car is designed for a shielded road cask weight of up to 50,000 lbs (22,676 kg).

Road Cask Maintenance Station

The road cask maintenance station, located adjacent to the road cask preparation area, provides space and equipment for periodic shielded road cask maintenance; this area lies within the operating envelope of the overhead bridge crane. If required, this area could be used for shielded road cask decontamination activities.

Hot Cell Complex

The hot cell complex provides the required facilities and equipment necessary to transfer canisters of RH TRU waste from the shielded road cask to the shielded facility cask. Facilities included within the hot cell complex are: the road cask unloading room, the hot cell, the canister transfer cell, and the facility cask loading room. The hot cell complex is designed for a 45 rem/h (0.45 Sv/h) neutron surface dose rate and a gamma surface dose rate of 400,000 rem/h (4,000 Sv/h). Viewing windows, equivalent to hot cell wall shielding, provide nearly 100 percent visual observation of all areas within the hot cell. Supporting facilities include an operating gallery, a hot cell HEPA filter gallery, a crane maintenance room, and a manipulator repair room. Details of the hot cell complex are shown in Figure 4.2-4a, Figure 4.2-4b and Figure 4.2-4c.

Road Cask Unloading Room

The road cask unloading room is a floor-level, concrete-shielded room where the shielded road cask is transferred by the road cask transfer car. A 140-ton concrete-filled shield door at the entrance to the road cask unloading room provides radiation protection for personnel outside the room during shielded road cask unloading operations. The shield door is supported by air bearings for ease of movement and interfaces with an inflatable seal.

Access to the hot cell above the road cask unloading room is through shielded floor plugs in the hot cell. These plugs must be in place when the shielded road cask enters the cask unloading room. An interlock is provided between the road cask unloading room shield door and the hot cell grapple, and requires that the door be closed in order to operate the grapple or to handle a waste canister. The unloading room ceiling incorporates a seal ring and road cask seal collar, with an inflatable seal, that mates with the upper surface of the road cask. When the shield door is closed and sealed, and the shielded road casks are mated with the seal collar, the road cask unloading room functions as an air lock between the hot cell (including the road cavity) and the RH Bay. The hot cell is maintained at the lowest negative pressure and air leakage, if any, would be from the RH Bay through the road cask unloading room to the hot cell itself.

Hot Cell

The hot cell is a concrete-shielded room where RH waste canisters are handled following removal from the shielded road cask. The hot cell is a shielded cell, and has provisions for maintenance of installed equipment. Air locks are provided for personnel access to the hot cell, and access is permitted only when RH canisters are not present.

Two ports are located in the floor of the hot cell: (1) an 8 ft 8 in (2.64 m) diameter port which also contains a concentric 2 ft 8¼ in (0.82 m) diameter port, and which connects with the road cask unloading room; and, (2) a 5 ft (1.52 m) square port which connects with the canister transfer cell. When closed, these ports provide shielding corresponding to the level of radiation protection required by the road cask unloading room and the facility cask loading room. Position switches are used to ensure the proper closure of the canister transfer cell port. The port connecting to the road cask unloading room also allows the transfer of shielded road cask heads into the hot cell.

The hot cell contains two primary workstations: an inspection station and a welding station. Inspection of the RH canisters, including visual inspection, verification of canister identification, and contamination checks are accomplished at the inspection station. If the results of this inspection show that overpacking of the canister is required, this will be accomplished at the welding station. At the welding station, the canister is inserted into an overpack body, and the closure is welded using remotely operated welding equipment.

The hot cell is equipped with a remotely operated 15-ton bridge crane, master/slave manipulators, a bridge mounted power manipulator, a portable overpack welder, a closed-circuit television system, a shielded pass through drawer, and various storage locations supporting hot cell operations.

The overhead bridge crane, equipped with a rotating block and grapple, is used for all heavy lifting operations within the hot cell, including handling of the hot cell shield plug(s), road cask inner closures, RH canisters, and canister overpack components. This crane is designed to stay on its tracks, and to maintain control of its load in the event of a DBE or electrical failure.

The master/slave manipulators are used to conduct detailed handling operations, including contamination checks at the inspection station and support functions at the welding station. A shielded transfer drawer is used to introduce small items into the hot cell, and to allow swipe materials to be checked. The bridge-mounted manipulator is provided to accomplish those specific operations that lie between the capability of the bridge crane and the master/slave manipulators. Various storage locations are provided within the hot cell, from change-out stations for the bridge mounted power manipulator tools, to overpack canister components.

Canister Transfer Cell

The canister transfer cell is located beneath the hot cell, and transfers canisters from the hot cell to the facility cask loading room via a seven position shuttle car. The cell includes provisions for a manual override tool to be used in the event of a grapple failure or to release the grapple from an RH canister, and is operated from an area shielded from the canister transfer cell. Canisters are lowered into the shuttle car by the hot cell bridge crane through a shielded valve in the floor of the hot cell. A ceiling-mounted hoist, located in the facility cask loading room, is used to remove canisters from the shuttle car through a shield valve in the floor of the facility cask loading room.

The shuttle car has chain drives, is equipped with retainers to ensure that the car stays on its tracks, and is designed to resist a DBE. Drive components are located outside of the canister transfer cell providing easy access for maintenance.

Facility Cask Loading Room

The facility cask loading room is the final element of the RH hot cell complex, and provides for transfer of the RH canister to the facility cask, which is subsequently transferred to the waste hoist and to the underground. This is accomplished by lifting the canister from the shuttle car through a shield valve, and into a vertically oriented facility cask positioned in the facility cask loading room. The shield bell, located above the facility cask, and the telescoping port shield valve mating with the underside of the facility cask, ensure shielding integrity. In addition, when the operating console is used during this operational sequence, it is located behind a shield. When loaded, the facility cask is rotated to the horizontal position, supported by the tracked facility cask transfer car, and is ready for transfer on the waste hoist. To control potential for contamination spread, the facility cask loading room functions as an air lock between the shaft and the hot cell.

RH Support Facilities

Facilities supporting RH operations are the hot cell operating gallery, the crane maintenance room, the manipulator repair room, and the hot cell filter gallery. The operating gallery provides the space for hot cell operating personnel to monitor and control all operations within the hot cell (Figures 4.2-4a, Figure 4.2-4b and Figure 4.2-4c). The master/slave manipulators are operated from this area, and are moved from this area to the manipulator repair room for maintenance and repair.

The manipulator repair room is adjacent to the operating gallery, and provides space for repairing the hot cell master/slave manipulators.

The hot cell filter gallery provides space for hot cell HEPA filters and personnel access for maintenance. The filters are normally changed manually, and in the event it becomes necessary, space is provided for remote filter removal (i.e., provision of oversized filter housings). Bag out provisions are incorporated in the design of the HEPA filter system.

The crane maintenance room provides space and facilities for maintenance of the hot cell bridge crane. With the hot cell bridge crane moved into the crane maintenance room and the shield door closed, maintenance personnel may safely enter the room even with a RH canister in the hot cell.

4.2.1.1.3 Building 412

Building 412 (designed as the TRUPACT maintenance facility) is Design Class IIIA; however, the structural portions of the building are Design Class II because of its interface with the WHB. Building 412 provides space and equipment for minor scheduled and unscheduled maintenance activities and includes a 25-ton overhead crane.

4.2.1.1.4 WHB Support Areas

WHB support areas, common to both the CH TRU and RH TRU areas of the WHB, include the waste hoist support areas and the main mechanical equipment room containing the HVAC equipment.

Air locks are located on both the CH TRU and RH TRU sides of the waste hoist, including the conveyance loading room on the CH TRU side of the waste hoist and the facility cask loading room on the RH TRU side of the waste hoist. Access doors to the hoist are interlocked to control air flow; and, air flow is towards the hoist from the CH TRU loading room, or from the RH TRU facility cask loading room.

The hoist control room provides space and equipment for operation of the waste hoist and controls available for operation in manual or automatic.

The main mechanical equipment room of the WHB houses the exhaust fans, HEPA filters (except for the hot cell HEPA filters, which are located adjacent to the hot cell), and the associated ducting that controls ventilation flow within the WHB.

4.2.1.1.5 Waste Handling Building Effluent Monitoring System

The WHB exhaust system is Design Class IIIA, the supply system is Design Class IIIB, and the HEPA filters and isolation dampers are Design Class II. The WHB ventilation system has a single discharge point, with most of the air coming from the WHB being processed through a prefilter and two stages of HEPA filters prior to its release to the environment. Some of the air may go down the waste shaft (Section 4.4.2.1). Station C is located downstream of the HEPA filters and continuously monitors for both alpha and beta-gamma airborne contamination. In addition to air monitoring, fixed air sampling is used to quantify the total amount, if any, of radioactivity released to the environment.

4.2.1.2 Exhaust Filter Building

The Exhaust Filter Building, containing the filtration equipment associated with the underground ventilation system, is adjacent to the exhaust shaft. During normal operations, air is pulled from underground areas, up the exhaust shaft, and discharged to the environment without the HEPA filtration units in service. In the event of an underground radiological event, airflow from the underground is diverted through the HEPA filtration units located in this building to remove airborne radioactive particulates from the air stream. The underground ventilation system is discussed in Section 4.4.2.3, and the Exhaust Filter Building layout is shown in Figure 4.2- 19.

The Exhaust Filter Building structure is classified as Design Class IIIA, and the HEPA filters and isolation dampers are Design Class II. The major areas within the Exhaust Filter Building are the filter room and support area. The filter room houses the HEPA filtration units. The support area includes two mechanical equipment rooms housing the building filtration units, the exhaust fans, the supply-air handling units, the motor control centers, and the air lock.

The effluent monitoring system at the Exhaust Filter Building is composed of two separate stations. Station A is located within the exhaust shaft, and will obtain its sample 21 ft (6.4 m) below ground level in this shaft. Station B is positioned downstream from the HEPA filtration system that is located in the Exhaust Filter Building. Station A contains radiation effluent monitors (REMS) for the detection of airborne alpha or beta-gamma contamination that will be used only for research. Each station contains fixed air samplers operated by the WIPP, one each for WID, the state of New Mexico Environmental Department, and the Environmental Evaluation Group, quantifying the total amount of radioactivity released to the environment.

4.2.1.3 Water Pumphouse

The Water Pumphouse, adjacent to the two water storage tanks (Figure 4.1-2a and 4.1-2b), contains two fire water pumps (one electric and one diesel), three electric domestic water pumps, and space for water chlorination equipment and chemical storage. The Water Pumphouse is an above ground steel frame and siding building classified as Design Class IIIB.

4.2.1.4 Support Building

The Support Building, adjacent to the WHB, houses general support services for activities at the WIPP facility. The Support Building is constructed of steel framing and sandwich panel siding, and is classified as Design Class IIIA. The main lateral force-resisting members of the Support Building are designed for DBE and DBT to protect the WHB from their structural failure.

4.2.1.5 Support Structures

The following support structures are designed to the Uniform Building Code (UBC), and are classified as Design Class IIIB support structures.

- Salt Handling Shaft Headframe and Hoist House
- Air Intake Shaft Headframe and Hoist House
- Main Warehouse Building
- Guard and Security Building
- Main Gatehouse
- Safety and Emergency Services Building
- Compressor Building
- Engineering Building
- Training Building

4.2.2 Shaft and Hoist Facilities

4.2.2.1 Shaft and Hoist General Descriptions

The WIPP facility utilizes four shafts:

- Waste Shaft
- Salt Handling (SH) Shaft
- Exhaust Shaft
- Air Intake Shaft (AIS)

These shafts are vertical openings extending from the surface to the underground disposal level as shown on Figure 4.1-2a, which shows the location of the shafts relative to surface features. All shaft construction and mining operations are in accordance with 30 CFR 57.[2]

The waste hoist system is designated as a Design Class IIIA; and, the SH shaft, the exhaust shaft, and the AIS hoist system are designated as Design Class IIIB. The waste shaft, SH shaft and AIS shaft are designed to resist the dynamic forces of the hoisting system. Shaft linings are designed based on expected hydrostatic heads in the Rustler Formation.

4.2.2.2 Shaft and Hoist General Features

The principal components of each shaft are the shaft collar (extending from above the ground surface to the top of the bedrock), the shaft lining (extending from the bottom of the collar to the top of the salt formation at about 850 ft (259 m) below the surface), and the key section that terminates the lining in the salt formation, with the remainder of each shaft being unlined.

The shaft collars are situated about 400 ft (122 m) above the historic flood plain of the Pecos River and the collar slab around the shaft, where used, is at a higher elevation than the surrounding ground.

The waste shaft, the SH shaft, and the AIS are equipped with conveyances, and all hoist towers are made of structural steel. The conveyances in the waste shaft and AIS are guided by steel cables (guide ropes), and the conveyance in the SH shaft is guided by fixed wooden guides, and is equipped with safety dogs. The waste shaft is equipped with catch sprags in the hoist tower to prevent the conveyance or counterweight from falling into the shaft if the conveyance overtraveled against the upper crash beam and the hoist ropes failed.

The waste hoist and SH hoist redundantly installed brake systems are designed for either set of brakes to stop the fully-loaded conveyance under all conditions. In the event of a power failure, the brakes will set automatically. The AIS hoist is also equipped with two sets of brakes.

The control system for each hoist detects malfunctions or abnormal operations (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong location) and triggers an alarm which automatically shuts down the hoist.

4.2.2.3 Shaft and Hoist Specific Features

The Waste Hoist system exists for the main purpose of moving radioactive waste from the surface to the underground. The system can be used to remove radioactive waste from the disposal area if required. It is also used to transport personnel, material and equipment. The system supports maintenance in the Waste shaft. The equipment that is part of this system is the Waste Hoist equipment installed in the Waste Handling building, the headframe, shaft switches, and the conveyance. The hoist systems in the shafts and all shaft furnishings are designed to resist the dynamic forces of the hoisting operations (these forces are greater than the seismic forces on the underground facilities). In addition, the Waste Hoist headframe is designed to withstand a DBE (the DBE is defined in Section 3.2.7). The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong direction), and will trigger an alarm that automatically shuts down the hoist. The waste shaft and hoist arrangement is shown on Figure 4.2- 20.

The inside diameter of the unreinforced concrete-lined upper portion of this shaft is 19 ft (5.8 m). The waste hoist conveyance (outside dimensions) is approximately 30 ft (9.15 m) high by 11 ft (3.35 m) wide by 15 ft (4.6 m) deep, and carries a maximum payload of 45 tons. The conveyance contains an upper and lower deck. During loading and unloading operations, the conveyance is steadied by fixed guides. At the station underground, rope stretch is removed by a chairing device that supports the weight of the conveyance and payload.

The Waste Hoist itself is an electrically driven friction hoist. The Hoist Motor is a 600 HP DC machine, designed for a maximum operating speed of 13.5 RPM. The hoists maximum rope speed is approximately 500 ft/min (2.54 m/s). The field is formed by wound poles, and is supplied with a constant DC current obtained from rectifying a 480 volt three-phase supply. The DC voltage magnitude and direction controls the speed and direction of the hoist. There is one silicon controlled rectifier (SCR) power supply to power the hoist. The brake system can safely stop and hold the conveyance without the drive motor. Automatic control circuitry will sense electrical problems with the drive motor and stop the hoist.

There are two brakes, mounted approximately 180 degrees apart, on each braking flange of the Hoist Wheel. These disc brakes (four total) are spring set, and are released by hydraulic pressure. Brake switches indicate brake set, release, and wear. A redundant hydraulic power supply exists to supply hydraulic pressure to release the brakes. Each pressure unit has its own motor, pump, and oil reservoir. There is an automatic switch over from the primary system to the standby system if the hydraulic pressure decreases below the set point. There is no automatic switchover from the standby system to the primary system. A timed back up pressure relief path exists to set the brakes if for any reason the brake pressure is not released within a few seconds after the application of the brake set signal.

Hoisting, Tail, and Guide Ropes are provided for the safe operation of the conveyance and the counterweight. The hoisting ropes are 1-3/8" (3.5 cm) diameter, fully locked coil bright steel ropes suitable for use with a friction hoist. The tail ropes are 2-1/4" (5.7 cm) diameter, nonrotating bright steel, with a synthetic fiber core. The three tail ropes approximately balance the weight of the six hoisting ropes. The guide ropes are 1-3/4" (4.45 cm) diameter, half-lock bright steel with internal and external lubrication and are designed to operate with minimal field lubrication only. There are four guide ropes for the conveyance and two guide ropes for the counter weight. Tension in these ropes is maintained by weights on the bottom of the ropes. The size of the weights are different to prevent harmonic vibrations during operation of the hoist.

A conveyance and counterweight overtravel arrestor system exists to stop them if the normal control system has failed. Four timbers are provided at the tower and the sump regions for both the conveyance and the counterweight to assist in absorbing energy to stop an over traveling conveyance or counterweight. Retarding frames rest in notches either at the top of the wood arresters (Sump Area), or at the bottom of the wood arresters (Tower area). The retarding frames have knives that cut into the timbers if driven by the conveyance or the counterweight.

If the conveyance over travels against the upper crash beams and the hoist ropes fail, safety lugs on the conveyance mate with pivoting dogs on the catchgear mounted in the headframe to prevent the conveyance from falling if the ropes break. The counterweight catchgear system functions in a similar fashion to stop the counterweight from falling. Each catchgear frame is mounted on a hydraulic shock absorber which absorbs energy from a descending conveyance or counterweight. Lever arms exist to raise the pivoting dogs if they are not supporting any weight.

Emergency stop buttons are provided at the Master Control Station (MCS) and all the control stations to effect an emergency stop of the hoist. These buttons are operable in all modes of hoist operation. These buttons will open the control power loop and set the hoist brakes. These buttons provide the most rapid means of bringing the hoist to a stop. A controlled stop button that will decelerate the conveyance before setting the brakes is located on the control panel, to the left of the MCS. This is a slower and softer stopping action than the emergency stop.

Twelve signals, two analog and ten contact, from the Waste Hoist Operation are transmitted to the CMR for remote monitoring. The analog signals are the hoist motor volts and amps. The contact signals are "Hoist Operation, Manual", "Hoist Operation, Semi-Auto", "Hoist, Abnormal Condition", "Emergency Stop", "Men Working in Shaft", "Waste on Hoist", "Personnel on Hoist", "Hoist, Up", and "Hoist, Down".

The Waste Hoist Signaling System consists of bells and lights activated by the operators at the MCS and the operating stations.

The SH shaft is used to transport mined salt to the surface, and to provide personnel transportation between the surface and the underground horizon. It also acts as a duct for supplying air to the underground mining and disposal areas, and is one route for the power, control, and communications cables. The hoist's maximum rope speed is approximately 1,800 ft/min (9.15 m/s). The shaft inside diameter is 10 ft (3.05 m) for the steel lined portion, and 11 ft 10 in (3.6 m) for the unlined portion.

The exhaust shaft is used as the opening to exhaust air from the underground disposal areas to the surface. The inside diameter of the lined portion of this shaft is 14 ft (4.3 m). The shaft lining is unreinforced concrete. The shaft key incorporates polymeric chemical water seal rings. The exhaust shaft collar does not utilize a building or headframe, and is sealed at the top by a 14 ft (4.3 m) diameter elbow that diverts exhaust air into the exhaust ventilation system.

The AIS is used primarily to supply the fresh air to the underground areas, and is also used for backup egress of personnel between the surface and the underground horizon. The hoist's maximum rope speed is approximately 830 ft/min (4.2 m/s). The inside diameter of the unreinforced concrete lined upper portion of this shaft is 16 ft (4.9 m).

4.2.3 Subsurface Facilities

4.2.3.1 General Design

The subsurface structures in the underground are located at 2,150 ft (655 m) below the surface and include the waste disposal, north, and support areas. The underground support areas provide the facilities to service and maintain all underground equipment for mining and disposal operations, monitor for radioactive contamination, and allow limited decontamination of personnel and equipment. The mining, north, and waste disposal areas are isolated from each other by air locks and bulkheads (Some mining construction activities may be required within an active disposal panel, however, these activities can be separated from the disposal processes and areas by time, ventilation controls, and temporary bulkheads). Transportation of waste containers from the waste hoist to the disposal panel(s) (Figure 4.2-21b) takes place within the CA (Figure 4.1-3).

The underground support facilities and their ventilation flows in the shaft pillar area are shown on Figure 4.2- 21a.

The support facilities on the disposal side provide a maintenance area, a vehicle parking area with plug-in battery charging, and a waste transfer station.

The support facilities on the mining side consist of a vehicle parking area, an electrical substation, a welding shop, a warehouse, offices, materials storage area, emergency vehicle parking alcoves, and a fueling station for diesel equipment. A mechanical shop is located in the north area.

An experimental area, separate from the other areas of the underground repository contained separate areas for evaluating the interaction of simulated waste and thermal sources on bedded salt under closely monitored, controlled conditions. The experimental area was deactivated in September 1996. The deactivation was accomplished by the construction of two light weight cementitious block walls. The walls are located just north of the N780 drift in the E300 and E140 entries. The light weight cementitious walls not only serve as a barricade preventing access but also isolate and prevent any measurable ventilation from entering or exiting the deactivated area.

Underground mining procedures and cavity dimensions incorporate the results of the salt creep analysis in DOE/WIPP 86-010, Waste Isolation Pilot Plant Design Validation Final Report.[1]

The mining area fuel dispensing room is in an alcove off the mining exhaust entry. This fuel dispensing room provides a location and pumping facilities for a portable fuel tank. The portable diesel tank hoisting and lowering is done through the waste shaft, or the SH shaft as required. An automatic dry chemical fire suppression system, with main and reserve tanks, is provided in the fueling area. Fire-generated smoke and fumes would be exhausted directly to the exhaust ventilation system.

The underground transporters are equipped with fire resistant fuel tanks. The transporter is a diesel-powered tractor trailer with an articulating frame steering system. The transporter has two sections; (1) a front section consisting of the tractor cab and diesel engine, and (2) the rear section consisting of a flat bed trailer with a ball screw driven pallet transfer system mounted in the middle of the bed. The pallet transfer system is designed to handle a load of 28,000 lb (12,698 kg). The tractor has a fully hydraulic power type of steering system with a direct drive hydraulic pump, an orbital valve operated by the steering wheel, and two steering cylinders located at the articulated joint. The axle brakes are air over hydraulic disc brakes with a dual master cylinder and separate circuits for the front and rear brakes. There is also a drive line disc brake which is used as a parking brake. This brake is automatically applied when air pressure falls from the normal 100 psi (7 kg/cm^2) level to below 45 psi (3.2 kg/cm^2). The brake can also be set manually from the tractor cab. The roller guided pallet mover with hook is screw driven by a full-length ball drive. After the hook is engaged to the facility pallet pin, operation of the ball screw is controlled from a switch in the tractor cab, which rotates the ball screw. This advances the ball nut and hook to the front of the trailer, sliding the facility pallet from the waste shaft conveyance on to the transporter trailer. The underground transporter is then ready to move the facility pallet to an underground disposal room or the facility pallet platform.

There are two 6 ton and one 4 ton diesel powered forklift trucks in the underground, which are equipped with push/pull attachments mounted on the forks. The 4 ton diesel powered forklift truck is normally used to emplace backfill super sacks with the Loron push/pull attachment mounted on the forks. The 6 ton capacity diesel powered forklift trucks equipped with push/pull attachments capable of handling 8,500 lb (3,855 kg) are provided to lift and transport waste containers and backfill super sacks. The forklift-attachment combination will handle the following combinations on slipsheets: a single 7-pack of 55 gallon (208 L) drums, a single SWB, a single TDOP, a stack of two 7-packs of 55 gallon (208 L) drums, a stack of two SWBs, or a single backfill super sack. The attachments can be removed if required for other tasks.

Standard battery powered 6 ton forklift trucks in the underground are as described in section 4.2.1.1.1.

The BRUDI attachment is used with a 6 ton forklift truck with the forks removed to handle waste containers on slip sheets. The BRUDI attachment is connected to the forklift truck front carriage. The BRUDI has a gripper which grips the edge of the slip sheet on which the waste containers sit, and a linkage assembly to pull or push the waste containers onto or off the platen. After the 6 ton forklift truck moves the waste containers to the emplacement location, the BRUDI pushes the waste containers into position after the forklift truck has raised or lowered the BRUDI platen to the proper height. The use of the BRUDI attachment prevents direct contact between waste containers and forklift tines.

Loron attachments with 4,200 lb (1,905 kg) and 8,500 lb (3,855 kg) capacity are available. The Loron attachments use the same push/pull technique as the BRUDI units described previously. The 4,200 lb (1,905 kg) capacity Loron is installed on the forks of a 4 ton capacity forklift and is used to emplace backfill super sacks of MgO backfill on top of the waste stacks. The 8,500 lb (3,855 kg) capacity Loron is installed on the forks of a 6 ton forklift, and is used to emplace either waste container packages or the backfill super sacks on top of waste sacks.

The SWB forklift fixture in the underground are identical to the SWB forklift fixture described in section 4.2.1.1.1, and is used to perform the same function.

4.2.3.2 TRU Waste Disposal Area

The disposal area (see Figures 4.1-3) provides space for 6.2 x 10^6 ft^3 (1.76 x 10^5 m^3) of TRU waste material in TRU waste containers of which up to 2.5 x 10^5 ft^3 (7.08 x 10^3 m^3) can be RH TRU waste. This area also includes the four main entries and the cross-cuts that provide access and ventilation. Figure 4.2-22 shows a typical waste container disposal configuration.

CH TRU waste may be received at the WIPP facility in seven-pack configuration, SWBs or TDOPs. The seven-pack of drums and SWBs will be stacked three high, and may be intermixed within rows and columns. TDOPs will be placed on the bottom row. 85-gallon overpacks will be placed on the top row only.

The ribs (pillars or walls) of the disposal rooms and entries are used for storing RH TRU waste canisters. RH TRU waste may be disposed in the same rooms as CH TRU waste.

The amount of TRU waste in each panel/room is limited by thermal, structural, and physical considerations, and emplacement is designed not to exceed 10 kW/acre. Based on current design and thermal constraints, a spacing of approximately 8 ft (2.4 m) between centers for RH TRU waste canisters has been specified, and a shield plug provides shielding between the canister and the room.

Typically main entries and cross cuts in the repository provide access and ventilation to the disposal area. The main entries link the shaft pillar/service area with the disposal area and are separated by pillars. Typical entries are 13 ft (4.0 m) high and 14 ft (4.3 m) wide. Each of the panels labeled Panels 1 through 8 will have seven rooms. The locations of these panels are shown in Figure 4.1-3. The rooms will have nominal dimensions of 13 ft (4.0 m) high by 33 ft (10 m) wide by 300 ft (91 m) long and are separated by 100 ft- (30 m) wide pillars.

If waste volumes disposed of in the eight panels fail to reach the stated design capacity, the DOE may choose to use the four main entries and crosscuts adjacent to the waste panels (referred to as the disposal area access drifts) for disposal, as follows:

E-300 will be mined to be 14 ft (4.3 m) wide and 12 ft (3.7 m) high
E-140 is mined to 25 ft (7.6 m) wide by 13 ft (4 m) high
W-030 and W-170 will be similar to E-300.

Presently, only the construction of these areas is planned. The above drifts extend from S-1600 to S-3650 (i.e., 2,050 ft long [625 m]). Crosscuts (east-west entries) will be 20 ft (6.1 m) wide by 13 ft (4 m) high by 470 ft (143 m) long. The layout of these excavations is shown on Figure 4.1-3.

Panel 1 is the first panel to be used for waste disposal, and was excavated from 1986 through 1988. Its rooms and access drifts have been rock-bolted to assure stability. Panel 1 has been rebolted with threaded bar rising resin anchors. In addition, Room 1 has been supplied with a supplementary roof-support system consisting of rock bolts, steel channel sets, and a wire-mesh and lacing system. The DOE intends to mine panels in the following order:

Final ½ Panel 10 (access drifts for Panels 1,2,7, and 8)
Panel 2
First ½ Panel 9 (access drifts for Panels 3,4,5 and 6)
Panel 3
Final ½ Panel 9
Panel 4
Panels 5 through 8

At normal operating (waste throughput) rates, rock bolting in Panels 2 through 8 may only be required locally (i.e. spot bolting). Rock fixtures used at WIPP comply with 30 CFR 57,[2] Subpart B. Each ground control support system installation is individually assessed and evaluated. As a result they vary from time to time and place to place.

A discussion of the design life of underground disposal rooms is included in Section 4.3.5. An evaluation of the effective life of the underground rooms in Panel 1 was performed during April 1991, by a panel of geotechnical experts. The panel members concluded that if no additional remedial measures were taken, the rooms in the panel would likely have a total life of seven to eleven years from the time of excavation using the installed roof support system, consisting of patterned mechanically anchored rockbolts. Experience in Panel 1 confirmed the conclusion of the expert panel.

Plans call for bolt systems installed in the future to equal or exceed the bearing characteristics of the bolts used in the primary pattern in Panel 1. The configuration of Panel 2 through 8 will be similar to Panel 1, therefore; the performance of these rooms should be similar to those in Panel 1. Supplementary support systems will further extend the effective life of the rooms, should they be required. A detailed discussion of initial and supplementary support systems is included in Section 4.3.5.

The support system will be subjected to longitudinal and lateral loading due to the rock deformation. The anchorage components may undergo lateral deformation due to offsetting along clay seams or fractures and increasing tensile loading. Rigid, non-yielding support systems are not designed to accommodate salt creep; however, they do respond to creep and continue to provide support during ductile behavior. Yielding support systems are currently being evaluated in the WIPP underground. These systems are designed to yield at predetermined loads, and provide support over their prescribed yield interval without maintenance. Preliminary data indicate that the design and performance of some of these systems are clearly superior to rigid systems in their ability to respond to salt creep while maintaining adequate ground support.

Because the disposal area access drifts must remain open and operational for a much longer period than any panel, they will require additional consideration from time to time. They are subject to regular and systematic inspection and evaluation, and appropriate ground control measures will be implemented whenever necessary.

The DOE will ensure that any room in which waste will be placed will be sufficiently supported to assure compliance with all laws and regulations. Creep and rock failure in WIPP excavations progress slowly. As a result, many years pass before any operationally significant instability could occur. This long period allows more than sufficient time for whatever actions are appropriate, such as additional monitoring, installing supplementary support, or taking other managerial and operational actions. Support is installed to the requirements of 30 CFR 57, Subpart B. Random checks are conducted by Quality Assurance/Quality Control personnel as each system is installed. Geotechnical monitoring, design, analysis, and planning are performed in addition to regulatory inspections, maintenance, and construction, as discussed in detail in Section 4.3.5.

The underground facilities ventilation system will provide a safe and suitable environment for underground operations during normal WIPP facility operations. The underground system is designed to provide control of potential airborne contaminants in the event of an accidental release or an underground fire.

The main underground ventilation system is divided into four separate flows (Figure 4.2-21a): one flow serving the mining areas, one serving the northern areas, one serving the disposal areas, and one serving the Waste Shaft and station area. The four main airflows are recombined near the bottom of the Exhaust Shaft, which serves as a common exhaust route from the underground level to the surface. The underground confinement/ventilation system is discussed in detail in Section 4.4.

4.2.3.3 Backfill

Magnesium oxide (MgO) will be used as a backfill in order to provide chemical control over the solubility of radionuclides. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill.

The MgO backfill will be purchased and received typically in two different containers: 1) a super sack typically holding 4,100 ± 50 lb (1859 ± 22.7 kg), and 2) a mini sack holding 26 ± 1 lb (11.8 ± 0.45 kg). Quality assurance requirements, such as material quality and quantity, will be addressed by using current quality assurance procedures in the procurement process and receipt inspection. The filled containers will be shipped by road or rail, and will be delivered underground using current shaft and material handling procedures and processes.

The mini sack will be a conical container with a nominal base diameter of 5.75 in. (14.6 cm), a nominal overall length of 33 in. (83.8 cm), and a nominal top diameter of 3 in. (7.6 cm). The mini sack shall be constructed of woven polypropylene material, coated or uncoated (alternate materials are acceptable subject to approval by WID Engineering prior to shipment). Poly Vinyl Chloride (PVC) material is not acceptable. It will have an integral handle/hook attached into the sack closure. Six sacks will be manually placed in the external voids of each seven-pack unit just before the seven-pack is positioned on the waste stack. The mini sack will be lifted up behind the shrink wrap around the top of the seven-pack, slid into place, and held there by the four inch (10.2 cm) hole in the lower slip sheet. See Figure 4.2-23. Once the sacks are in place, the seven-pack will be positioned on the waste stack in the normal manner.

A similar process will be used for standard waste boxes (SWB), except that the sacks will be hung from the lift clips on these units. See Figure 4.2-23.

Super sacks will be handled and placed using the slip sheet/BRUDI technique used for normal waste handling operations. Hence, no new procedures or training are required. Once each row of waste units is in place, a layer of super sacks will be placed on top of them. See Figure 4.2-24. The assembled (empty) dimensions of the super sack shall be a hexagon which is nominally 61 in. (155 cm) across the flats by 24.5 in. (62.2 cm) high. The super sack shall be constructed such that it retains its shape well enough to not deform beyond a 65 in. (165 cm) hexagon with 12 in. (30.5 cm) radius corners after filling and shipping. The super sack shall be constructed of woven polypropylene material, with a minimum weight of 8.0 ounces per square yard, coated or uncoated (alternate materials are acceptable subject to approval by WID Engineering prior to shipment). Poly Vinyl Chloride (PVC) material is not acceptable. The filled super sack must be able to retain it’s contents for a period of two years after emplacement without rupturing from it’s own weight. The super sack will have an integral slip sheet or base attachment so that it can be handled and placed in a manner that is identical to emplacement of waste units, using a BRUDI-like attachment (a low-headroom push-pull device from Loron, Inc.) on a lift truck.

Finally, mini sacks will be manually stacked on the floor in the space between the waste stack and rib side. These sacks can be placed horizontally or vertically as may be convenient, and loading rates up to 100 lb per linear ft (148.8 kg per linear m) can be achieved.

Quality control will be provided within waste handling operating procedures to record that the correct number of sacks (six) are placed.

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner.

4.2.3.4 Panel Closure System

Chapter 10 discusses the Closure Plan that describes the activities necessary to close the Waste Isolation Pilot Plant (WIPP) facility. The Closure Plan describes several types of closure. The first type is panel closure, which occurs as underground panels are filled. Secondly, final closure at the end of the Disposal Phase is described.

Following completion of waste emplacement in each underground panel, disposal-side ventilation will be established in the next panel to be used, and the panel[3] containing the waste will be closed. A panel closure system will be emplaced in the panel access drifts, as shown in Figure 4.1-3. The panel closure system is designed to meet the following requirements that were established by the DOE for the design[3]:

- The panel closure system shall consider potential flow of VOCs through the disturbed rock zone (DRZ) in addition to flow through closure components.

- The panel closure system shall perform its intended functions under loads generated by creep closure of the tunnels.
- The panel closure system shall perform its intended function under the conditions of a postulated methane explosion.
- The nominal operational life of the closure system is 35 years.
- The panel closure system for each individual panel shall not require routine maintenance during its operational life.
- The panel closure system shall address the most severe ground conditions expected in the waste disposal area.
- The design class of the panel closure system shall be IIIB (which means that it is to be built to generally accepted national design and construction standards).
- The design and construction shall follow conventional mining practices.
- Structural analysis shall use data acquired from the WIPP underground.
- Materials shall be compatible with their emplacement environment and function.
- Treatment of surfaces in the closure areas shall be considered in the design.
- Thermal cracking of concrete shall be addressed.
- During construction, a QA/QC program shall be established to verify material properties and construction practices.
- Construction of the panel closure system shall consider shaft and underground access and services for materials handling.

The final panel closure design[3] was prepared with the assumption that there would be no backfill in the disposal rooms. With the inclusion of backfill, the design has been re-examined, and it has been determined that the changes are insignificant for several reasons. First, the backfill has no effect on the gas generation rate so that the values used in the design for gas generation and methane buildup remain the same. Second, the quantity of backfill is sufficient to fill one-tenth of the void volume in the room. This results in more rapid pressurization of the room; however, the effect is small and will only be important after the facility is sealed. Third, the reduced volume will result in a faster concentration buildup of methane. This would not result in a revision of the design. Instead, it would change the criteria for installing explosion walls.

The design for the panel closure system calls for a composite panel barrier system consisting of a rigid concrete plug with or without removal of the DRZ, and either an explosion-isolation wall or a construction-isolation wall. The design basis for this closure is such that the migration of hazardous waste constituents from closed panels during the operational and closure period would result in concentrations at the WIPP facility well below health-based standards. The source term used as the design basis included the average concentrations of VOCs from CH waste containers, as measured in headspace gases through January 1995. The VOCs are assumed to have been released by diffusion through the container vents, and are assumed to be in equilibrium with the air in the panel. Emissions from the closed panel occur at a rate determined by gas generation within the waste and creep closure of the panel. Due to the relatively small amount of RH waste (approximately five percent of the total waste volume), VOC emissions from RH waste are assumed to contribute insignificantly to total VOC emissions. This design meets the environmental performance standard.

Figures 4.2-25 and 4.2.26 show diagrams of the panel closure design and installation envelopes. Reference 3 provides the detailed design, and the design analysis for the panel closure system. The panel closure design is such that components can be added or removed, or their shapes adjusted depending on the particular ground conditions at the time of installation. For example, in Reference 3, Option A represents the likely closure of panels less than 20 years old at the time of final facility closure, and whose entries are sufficiently intact such that DRZ removal is not needed. These would likely include Panels 6 through 8. Option B represents the preferred option for panels that will be closed for more than 20 years prior to final facility closure, and whose entries are reasonably intact at time of closure. These will likely be Panels 2 through 5. Option C may be desirable for panels whose entries require DRZ removal, and whose closure precedes final facility closure by less than 20 years. This is the likely configuration of the closure for Panels 9 and 10. Finally, Option D may be appropriate for panels whose entries require significant removal of the DRZ, and whose closure will precede final facility closure by more than 20 years. Panel 1 is the most likely candidate for this type of closure.

The 20-year limit in the design selection process is based on what the DOE believes to be conservative analytical results that indicate methane, being generated by waste degradation at the rate of 0.1 mole per drum per year, will not reach flammable concentrations for at least 20 years. As part of the decision making process on design selection, an investigation of the DRZ would precede the selection of the concrete component and the specification of the amount of excavation that is needed. These investigations could be done using geophysical methods (such as ground penetrating radar) or drill holes. Drill holes can be investigated using video cameras or "scratchers." The DOE considers the 20-year criterion is still appropriate, since the design report shows that it takes 25 years to reach explosive limits. A ten percent reduction in this time is still beyond 20 years. Furthermore, the chances that methane will be generated initially are minimized by the fact that the closed panels will be initially oxic and may remain so for a long time after facility closure.

The DOE believes that design Options A through D will function adequately as panel closures, given the current state of knowledge about gas generation, the understanding of the DRZ, the expected characteristics of the waste, and the inability of monitoring techniques to accurately detect extremely small concentrations of VOCs. However, in the event sufficient information is collected that allows the DOE to make less conservative assumptions regarding these items, the designs A through D may prove to provide significantly more protection than is actually needed. Consequently, the DOE has retained as a design concept, Option E, which is simply the explosion wall portion of Options B and D. Option E represents a significantly simpler panel closure system that the DOE would use if either of the following criteria are met as indicated:

- Gas generation rates are smaller. Current (unreported) work being performed by Sandia National Laboratories indicates that microbial gas generation rates under humid conditions are close to zero, and/or

- Average headspace concentrations are less than the averages used in the calculations. As new wastes are generated, the use of organic solvents is expected to drastically be reduced.

As stated previously, the DOE will evaluate these criteria at the time a panel closure is needed and will select the proper closure design.

References for Section 4.2

1. DOE/WIPP 86-010, Waste Isolation Pilot Plant Design Validation Final Report.

2. Safety and Health Standards - Underground Metal and Nonmetal Mines, 8th edition, 1994. Title 30, Code of Federal Regulations, Part 57.

3. Detailed Design Report for an Operational Phase Panel-Closure System, DOE/WIPP-96-2150, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, New Mexico.

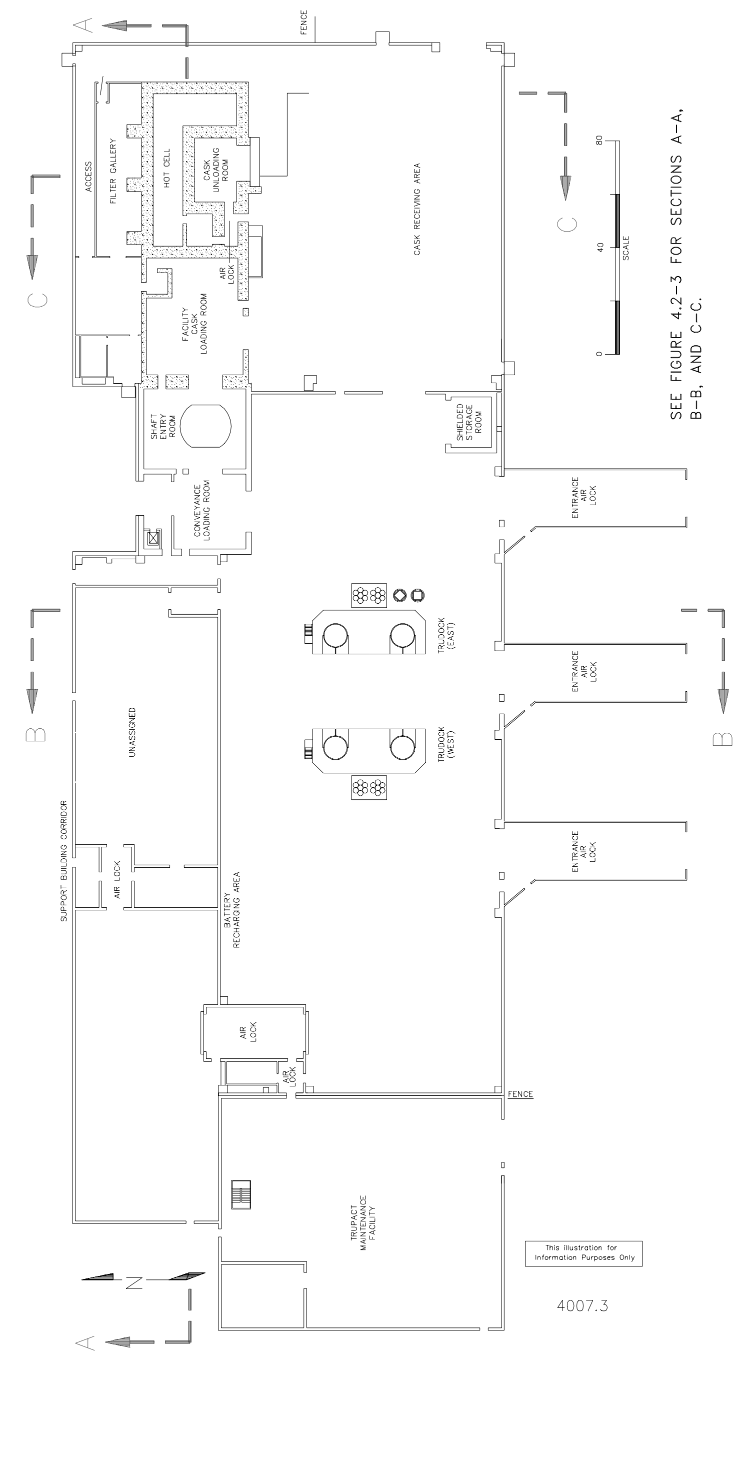

Figure 4.2-1a, WHB Plan (Ground Floor)

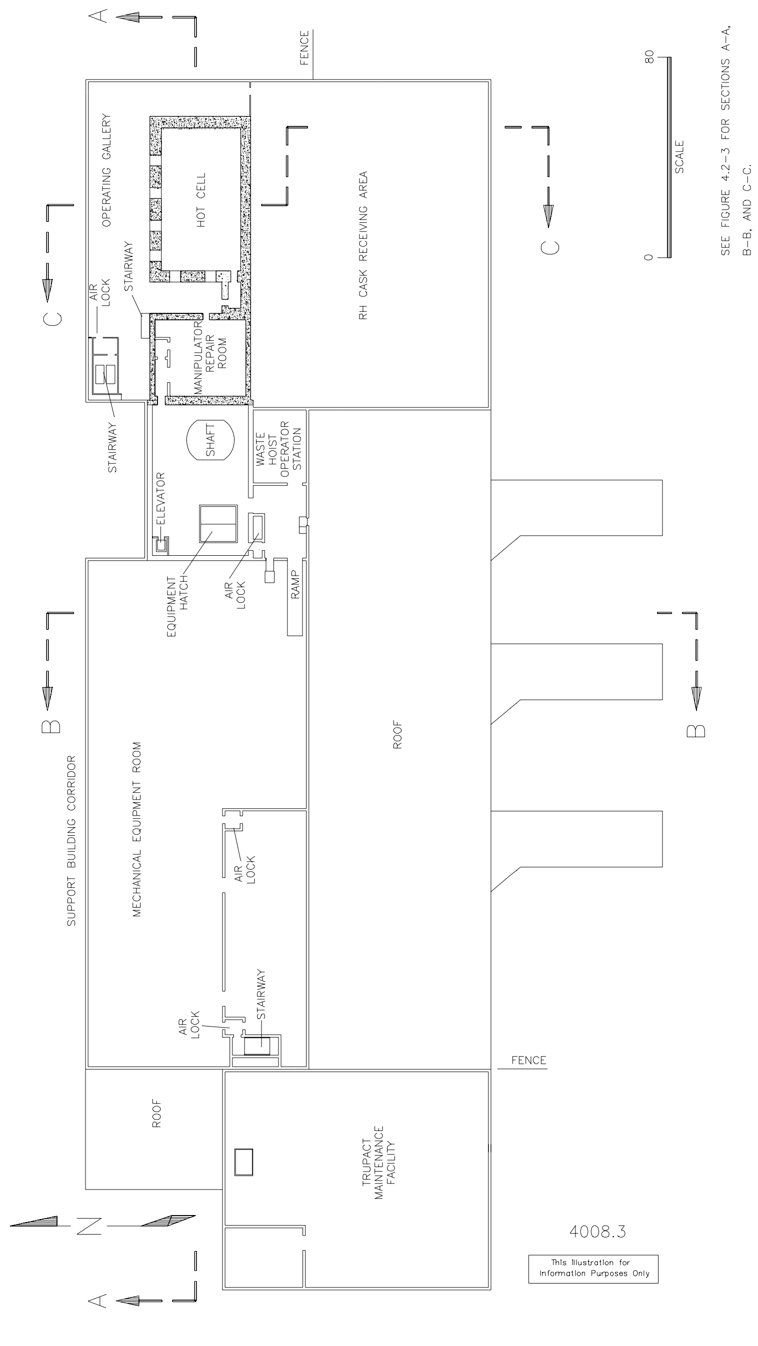

Figure 4.2-1b, Waste Handling Building Plan (Upper Floor)

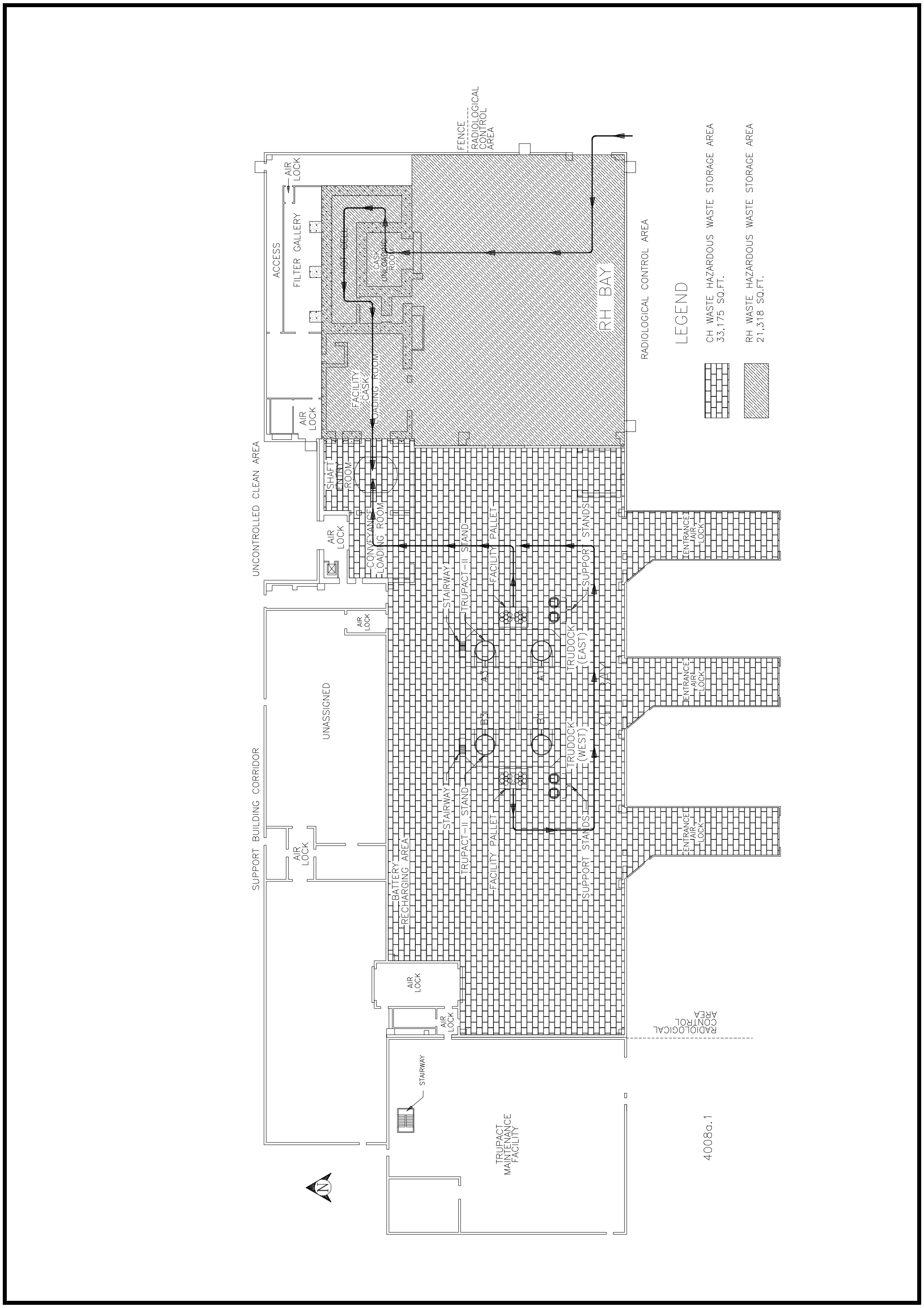

Figure 4.2-2, Waste Transport Routes in the Waste Handling Building

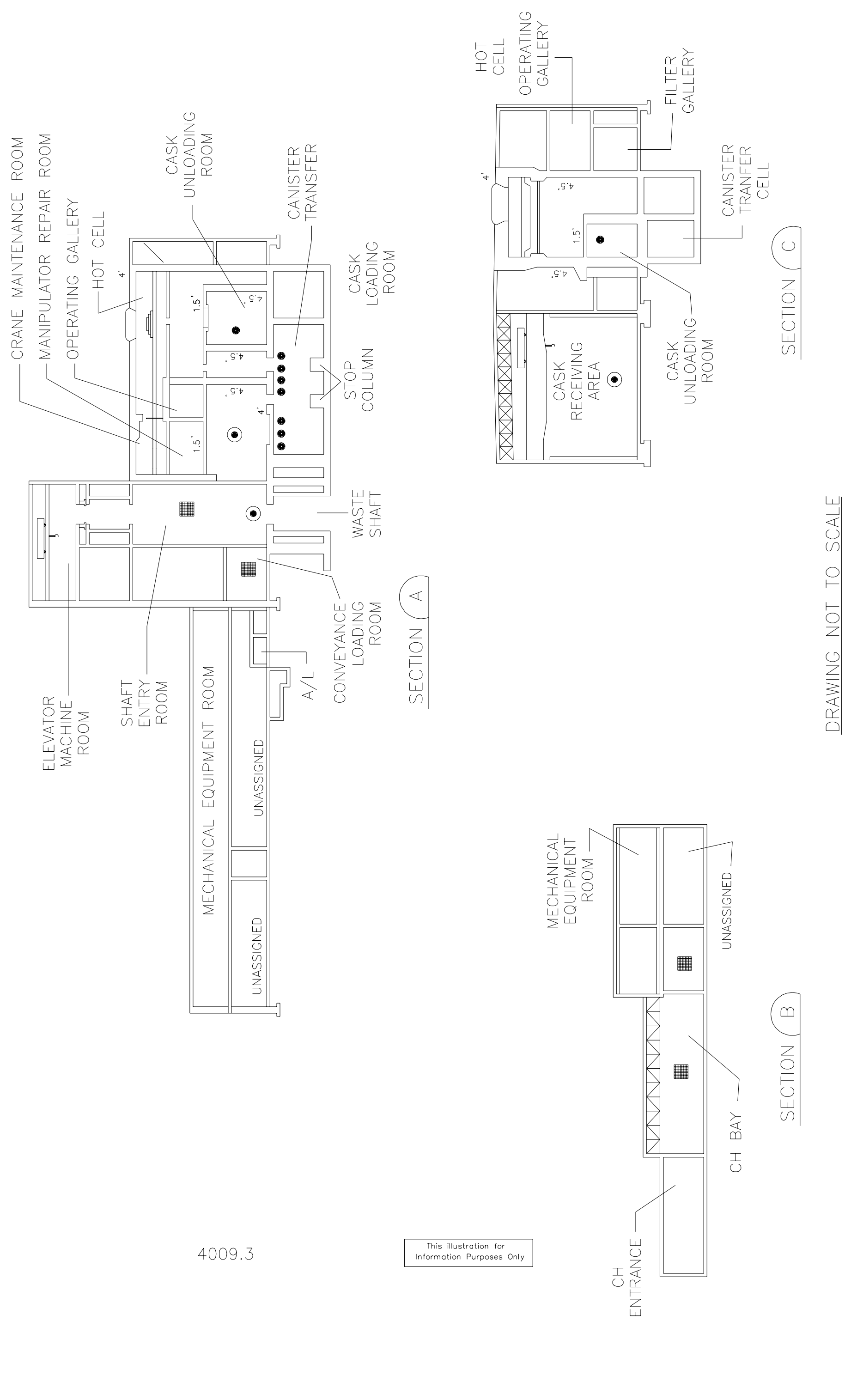

Figure 4.2-3, Waste Handling Building (Sections)

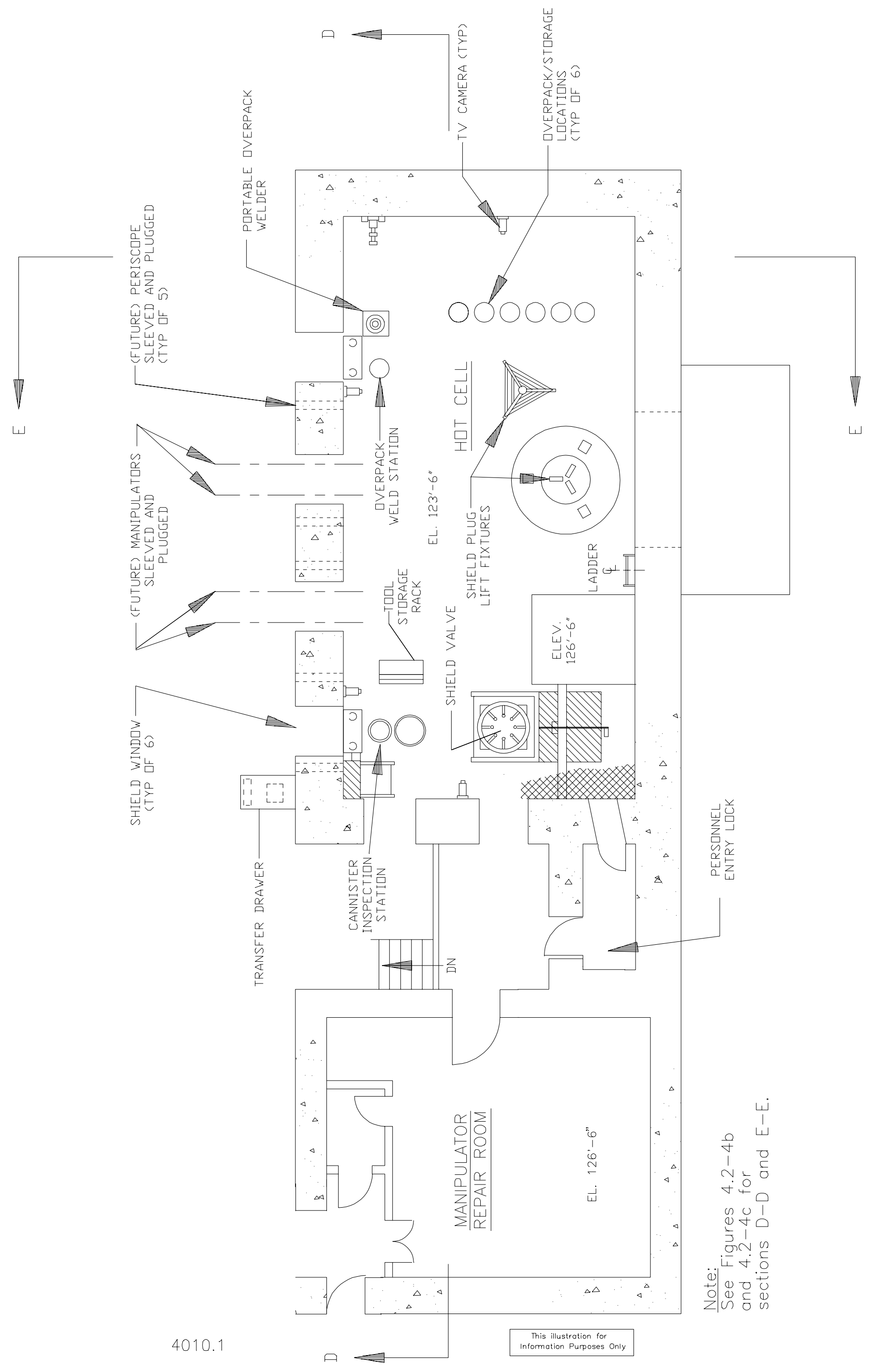

Figure 4.2-4a, Details of Hot Cell

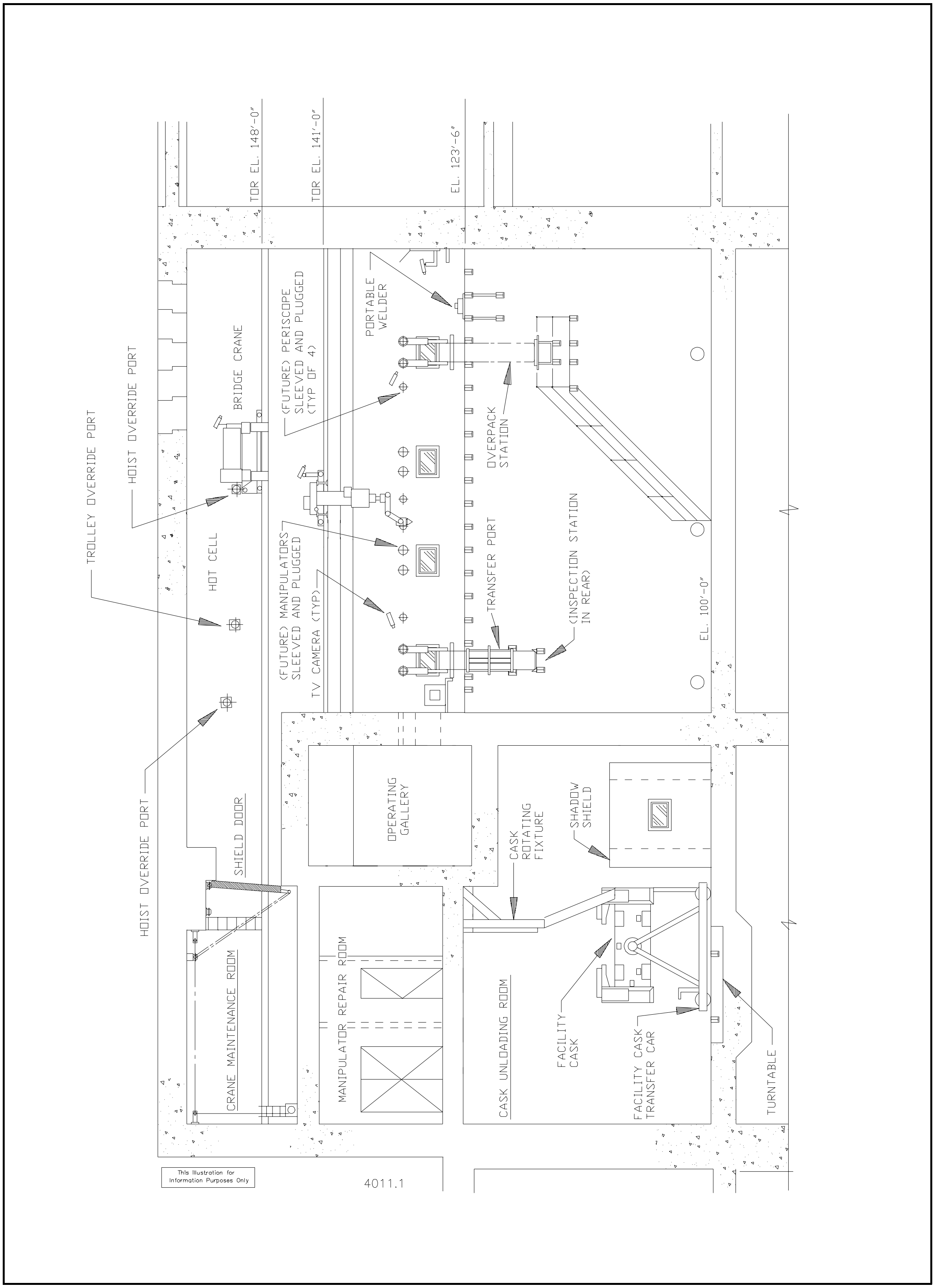

Figure 4.2-4b, Details of Hot Cell Cross Section at D-D

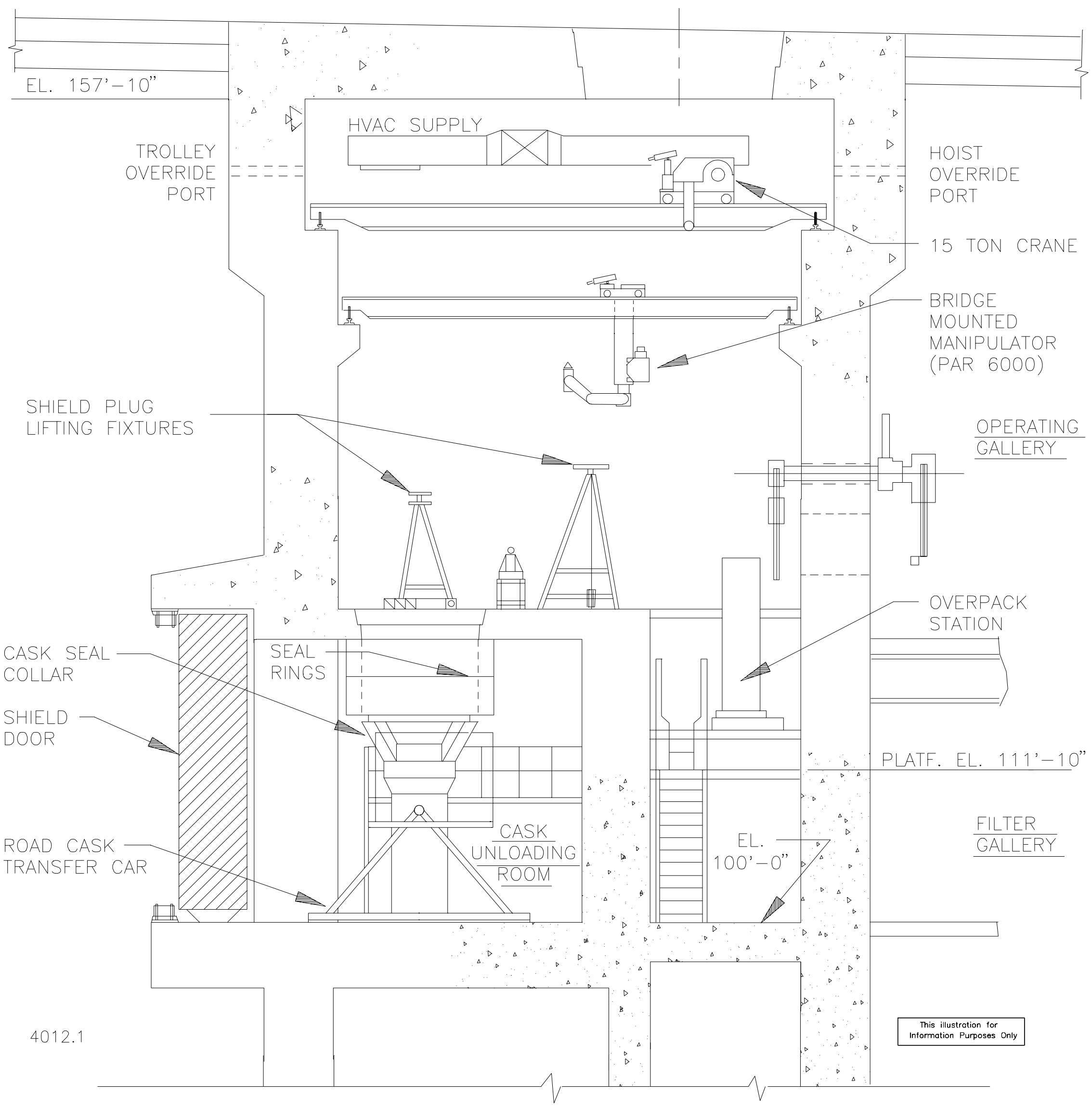

Figure 4.2-4c, Details of Hot Cell Cross Section at E-E

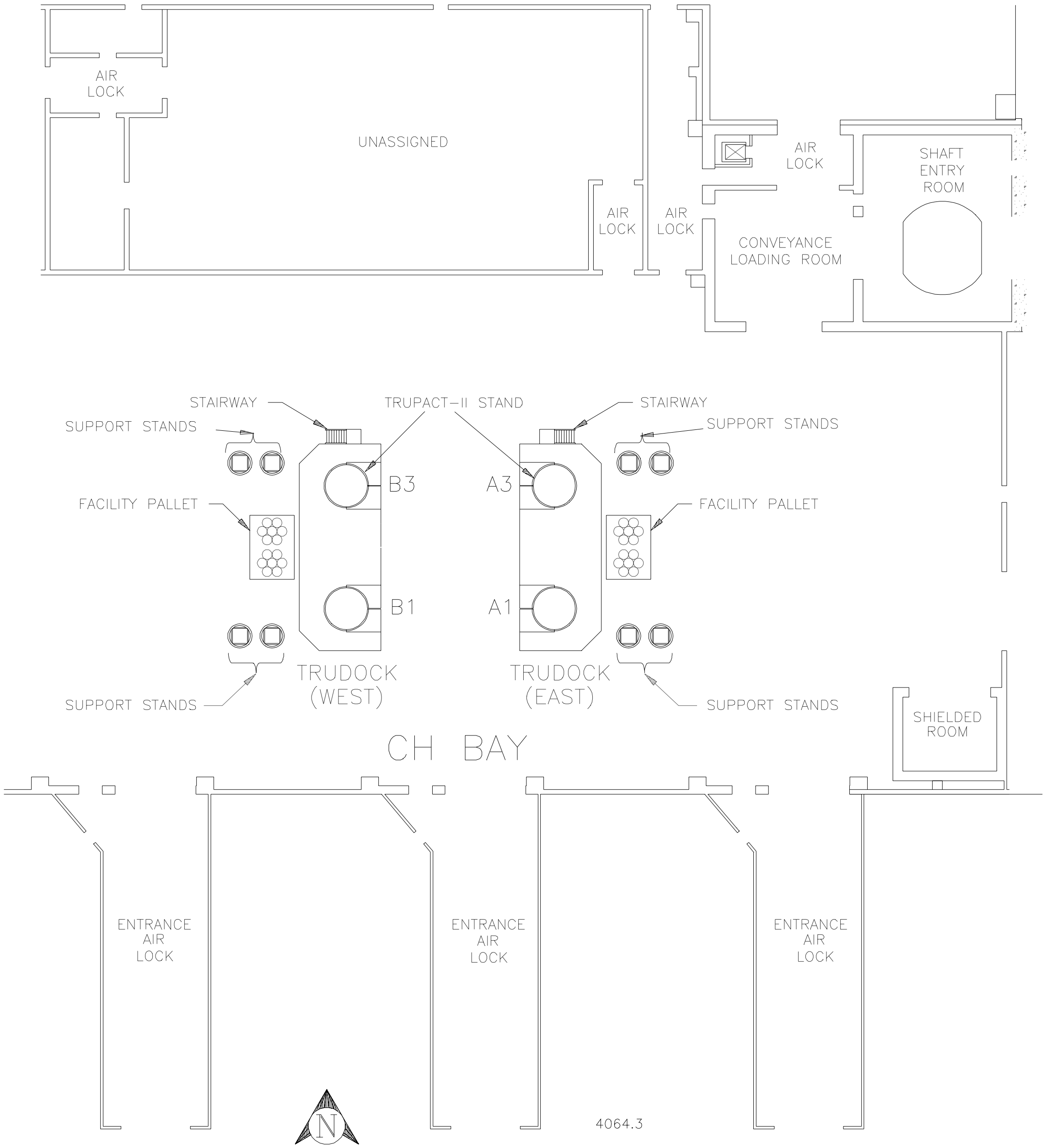

Figure 4.2-5, Configuration of CH TRU Waste Unloading TRUDOCKS in the WHB

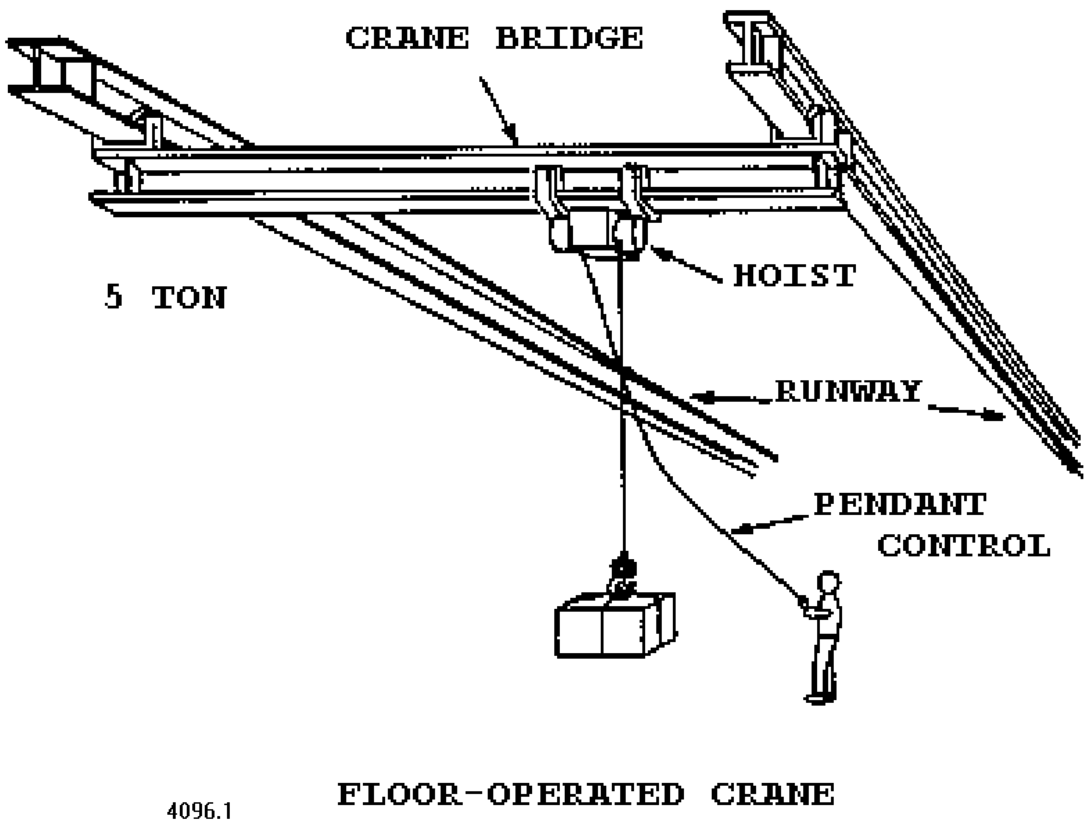

Figure 4.2-6, Typical Overhead Crane

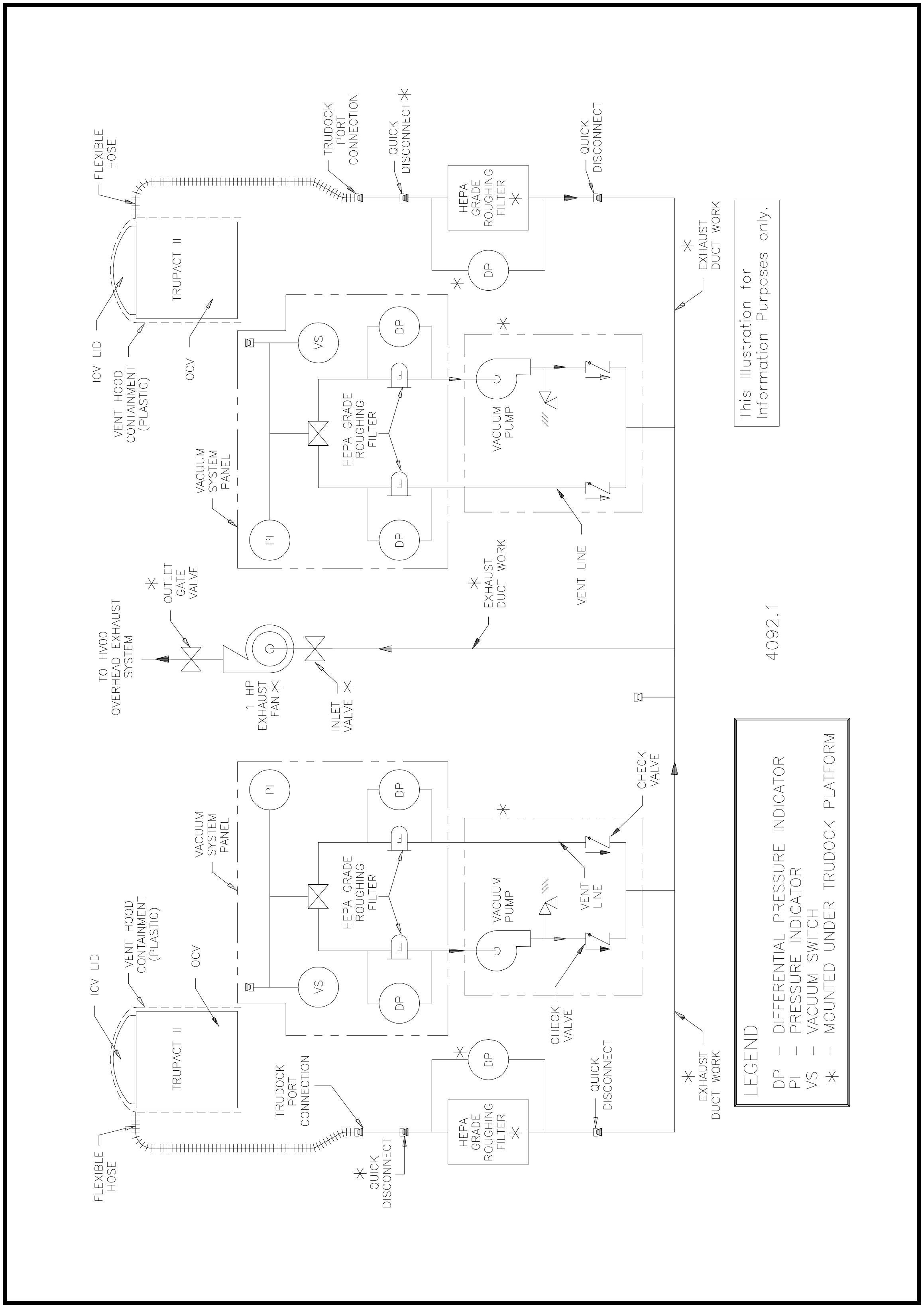

Figure 4.2-7, TRUDOCK Exhaust System

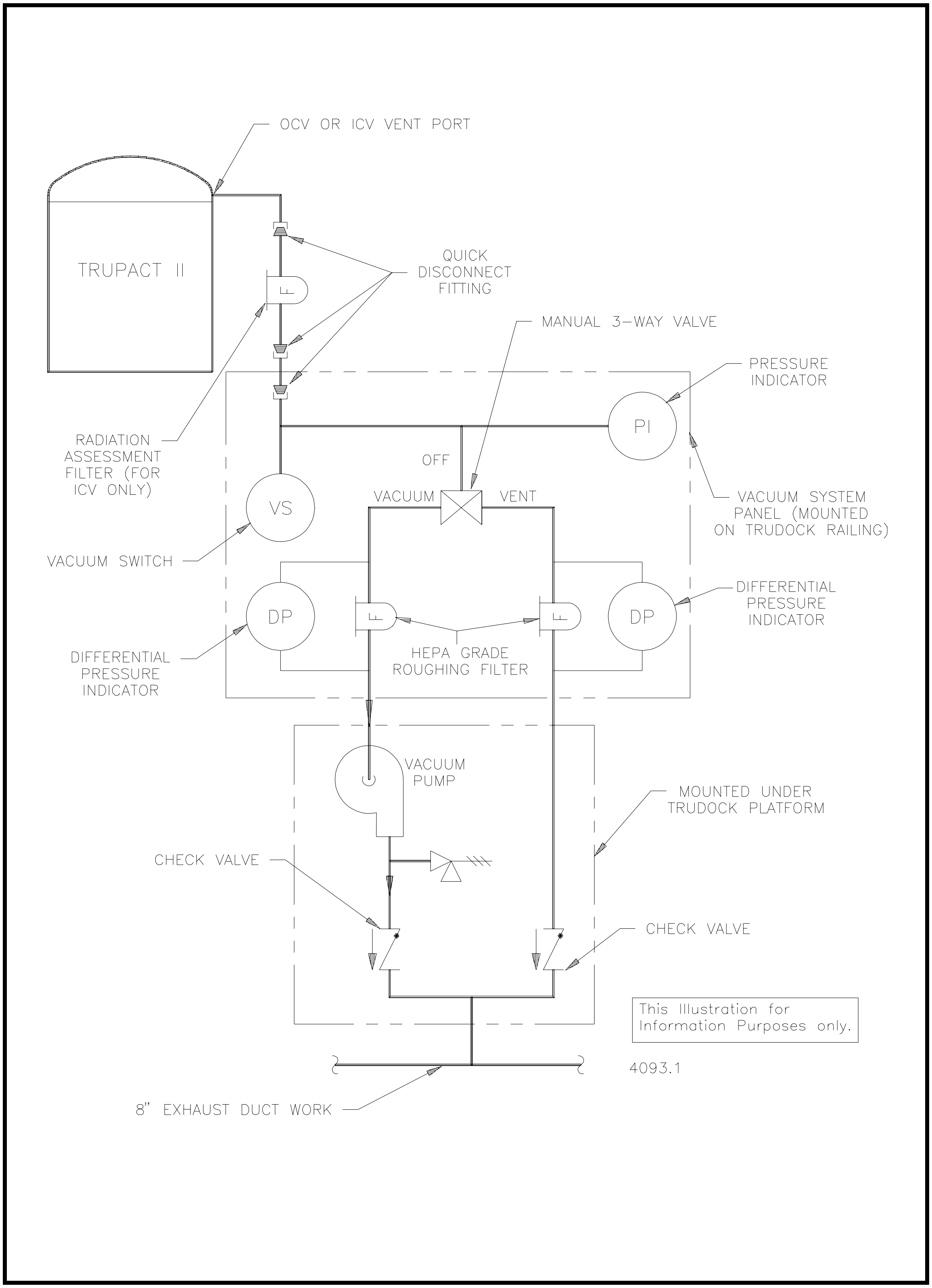

Figure 4.2-8, TRUDOCK Vacuum System Schematic

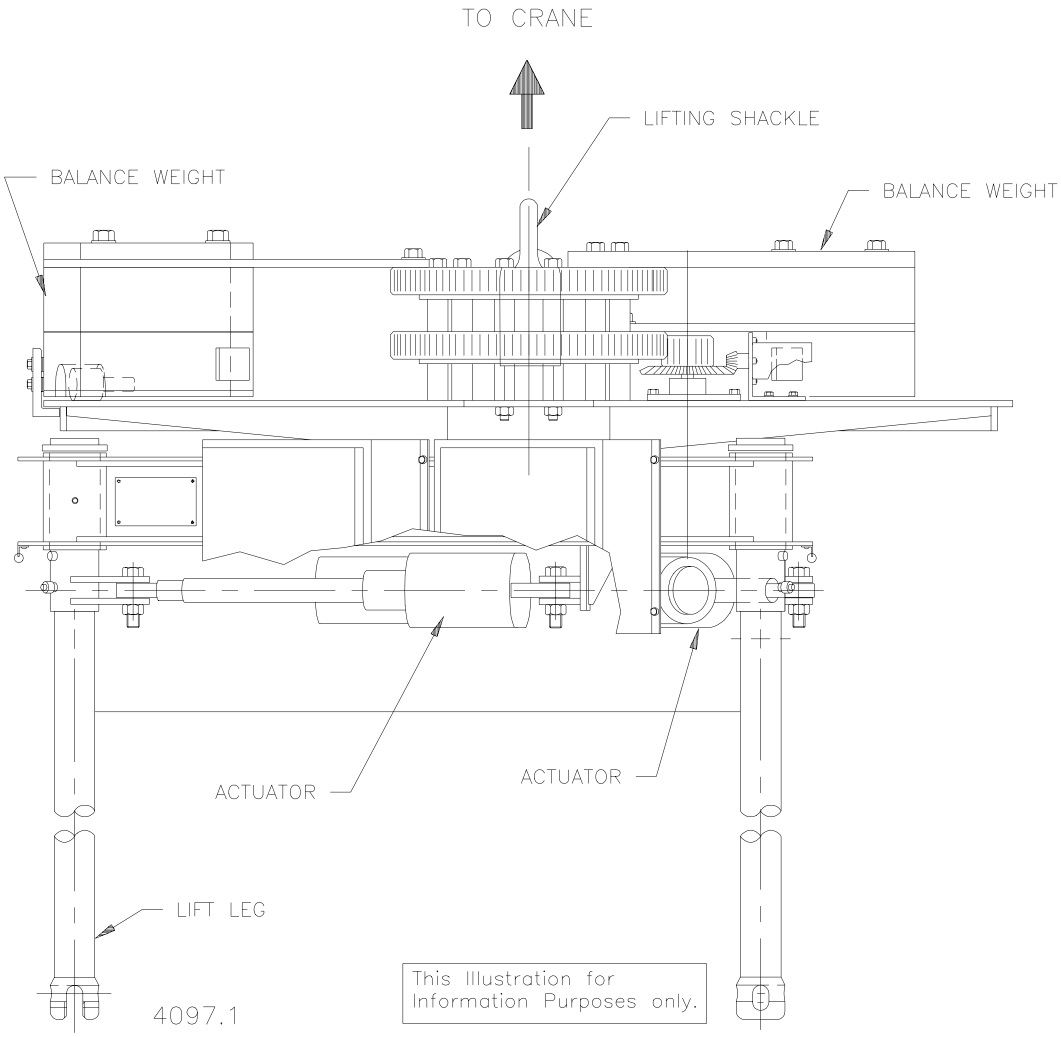

Figure 4.2-9, Adjustable Center of Gravity Lift Fixture

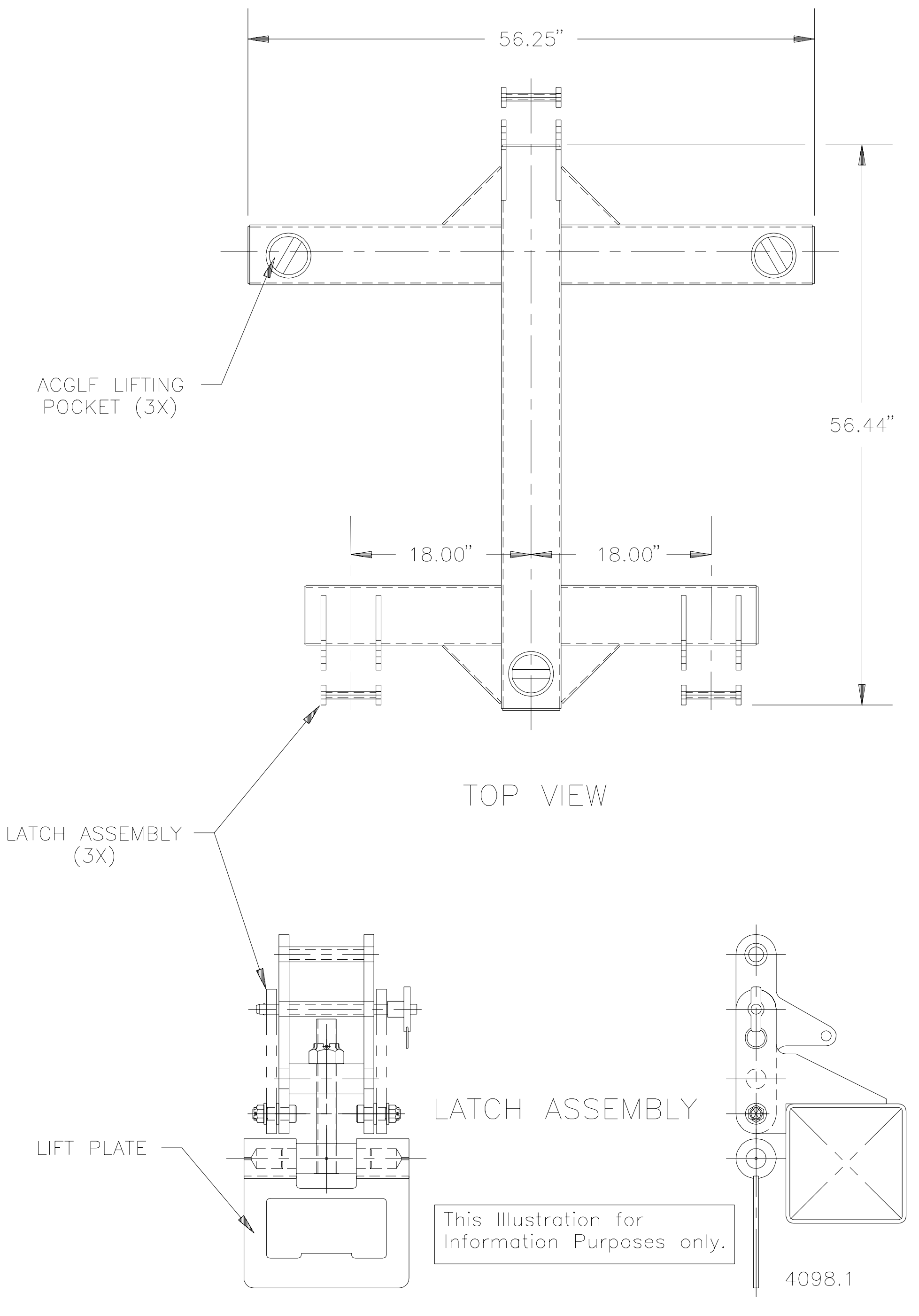

Figure 4.2-10, SWB Lift Fixture Adapter

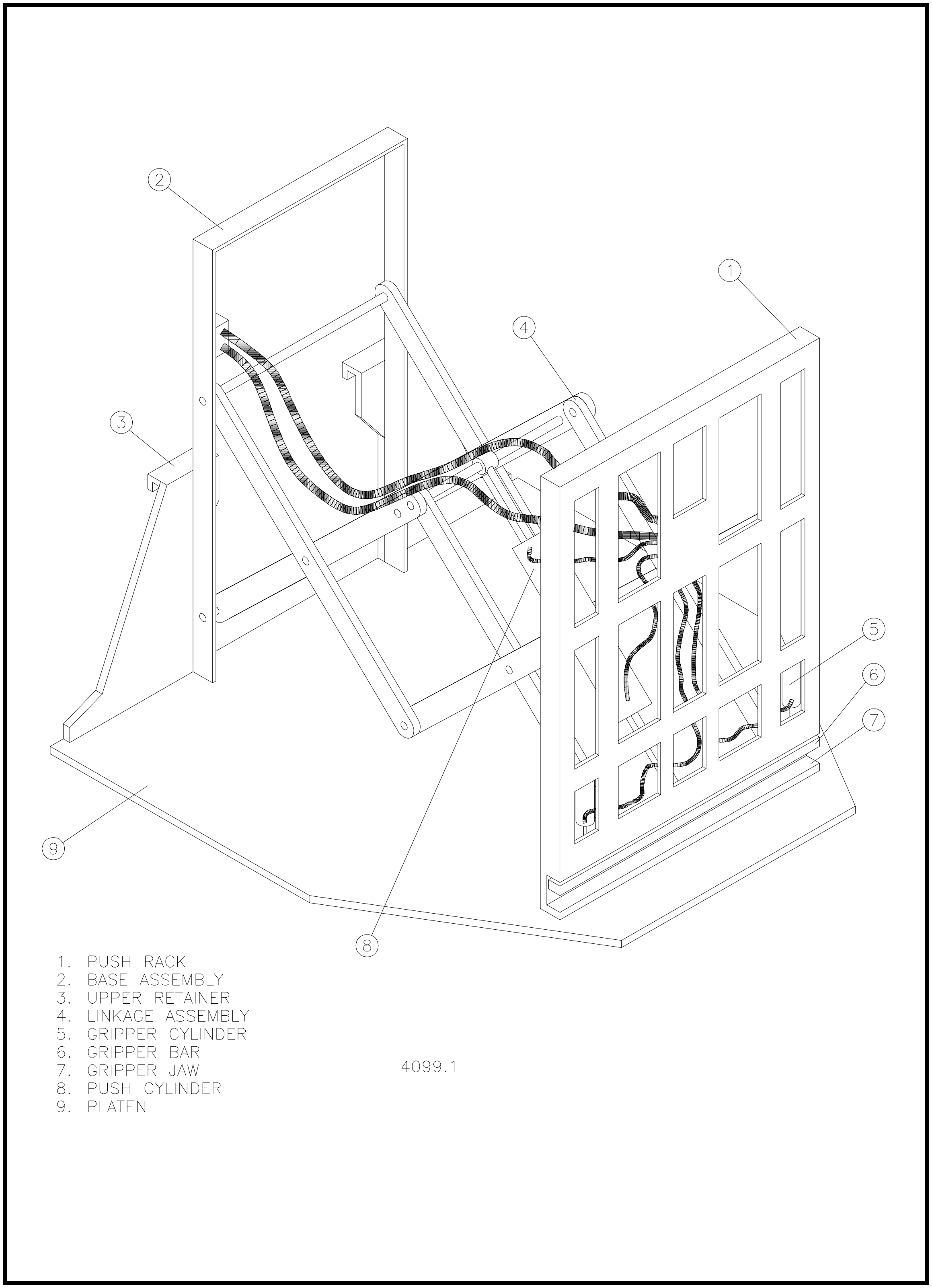

Figure 4.2-11, Brudi Attachment to allow Handling of Waste Containers

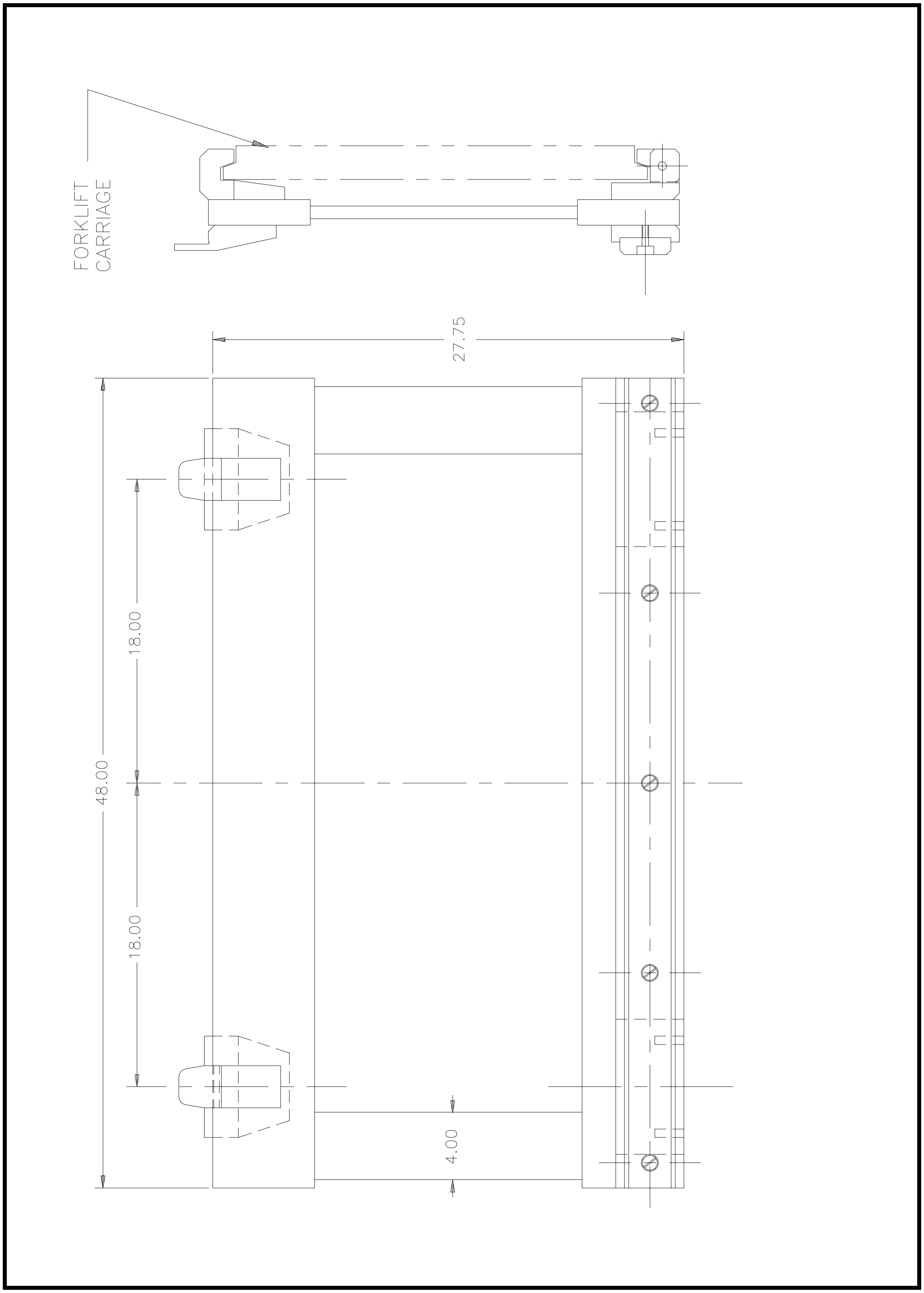

Figure 4.2-12, SWB Forklift Fixture

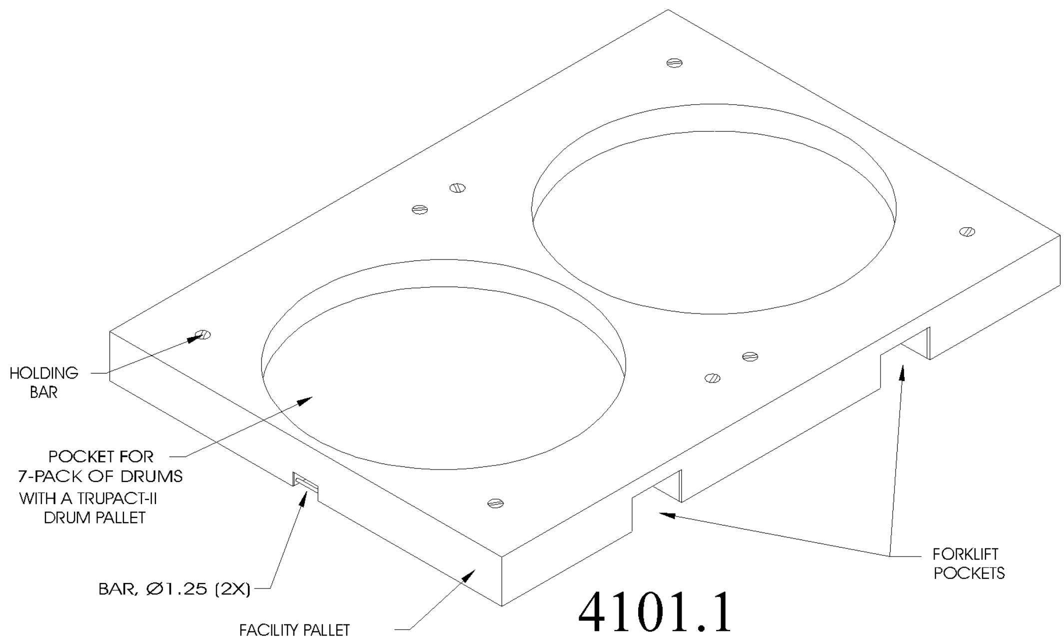

Figure 4.2-13, Facility Pallet

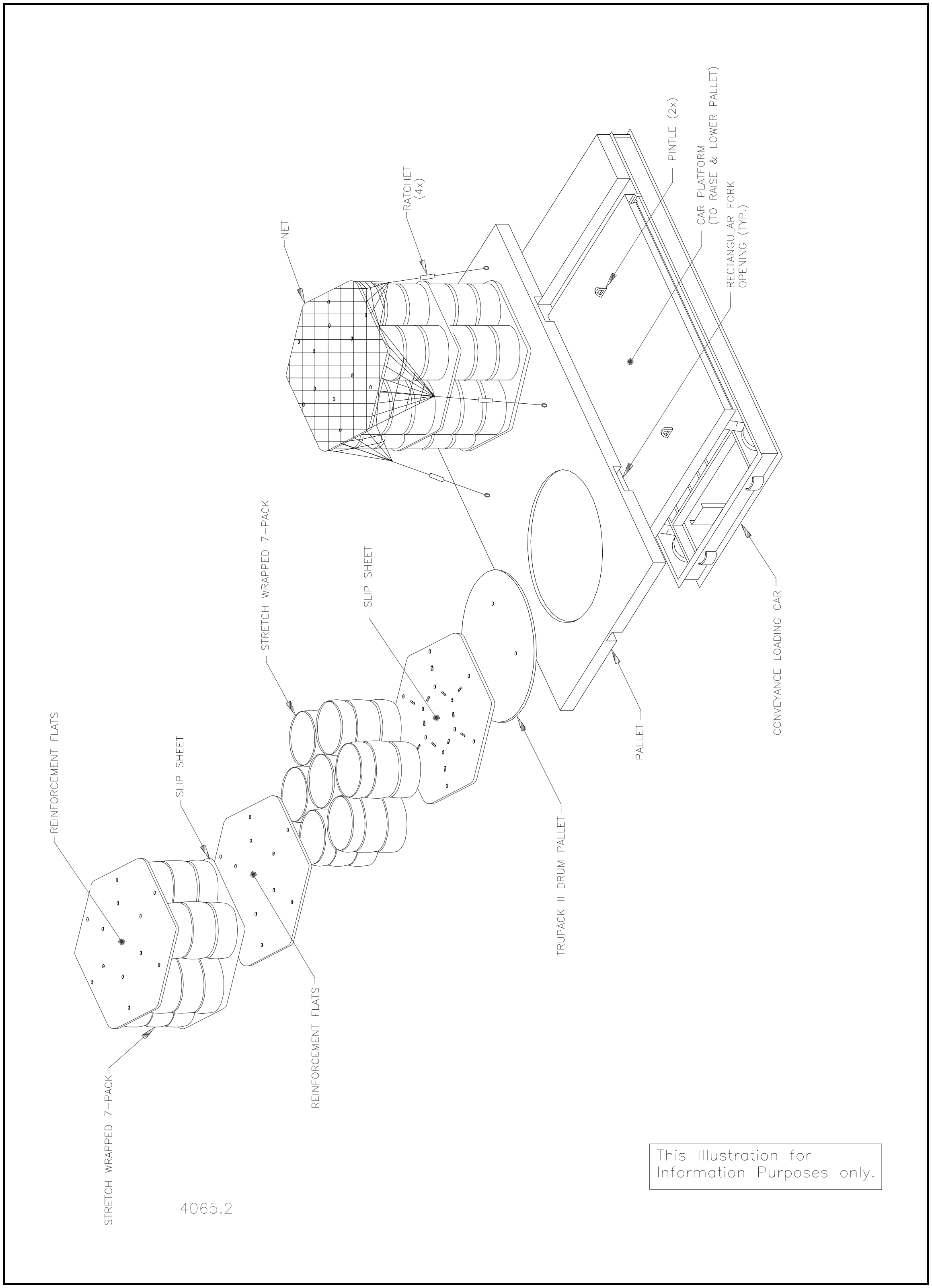

Figure 4.2-14, CH TRU Waste Pallet on Conveyance Loading Car

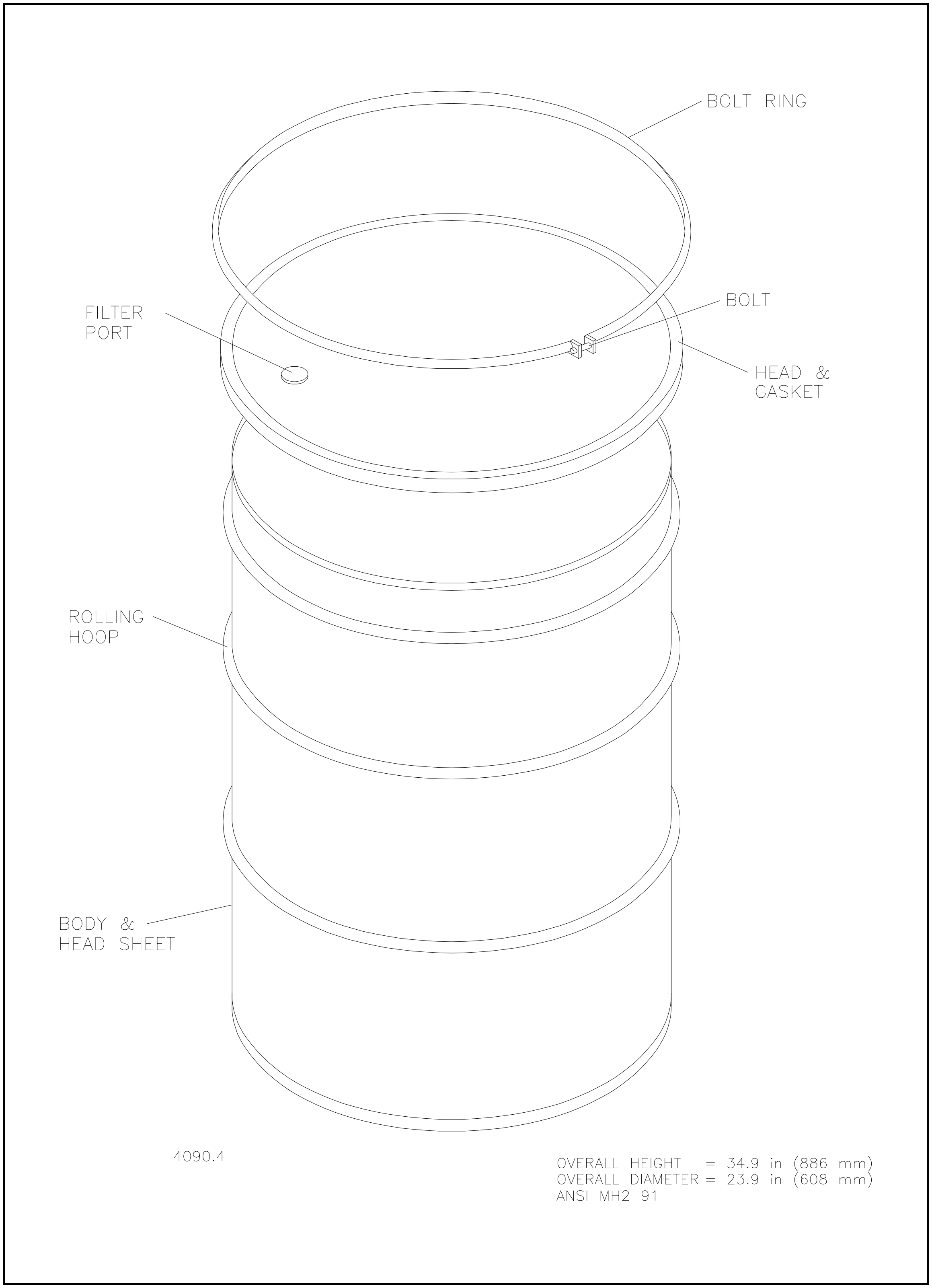

Figure 4.2-15, Standard 55-Gallon Metal Drum

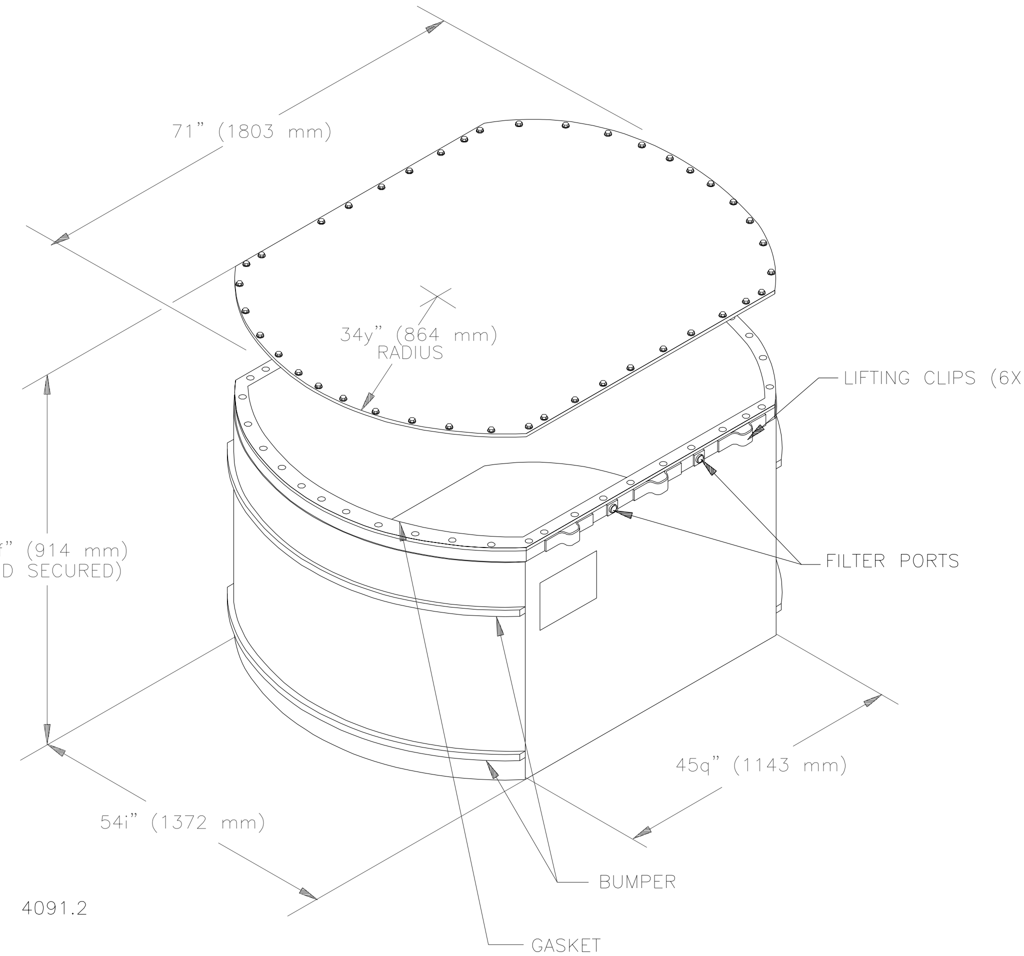

Figure 4.2-16, Standard Waste Box

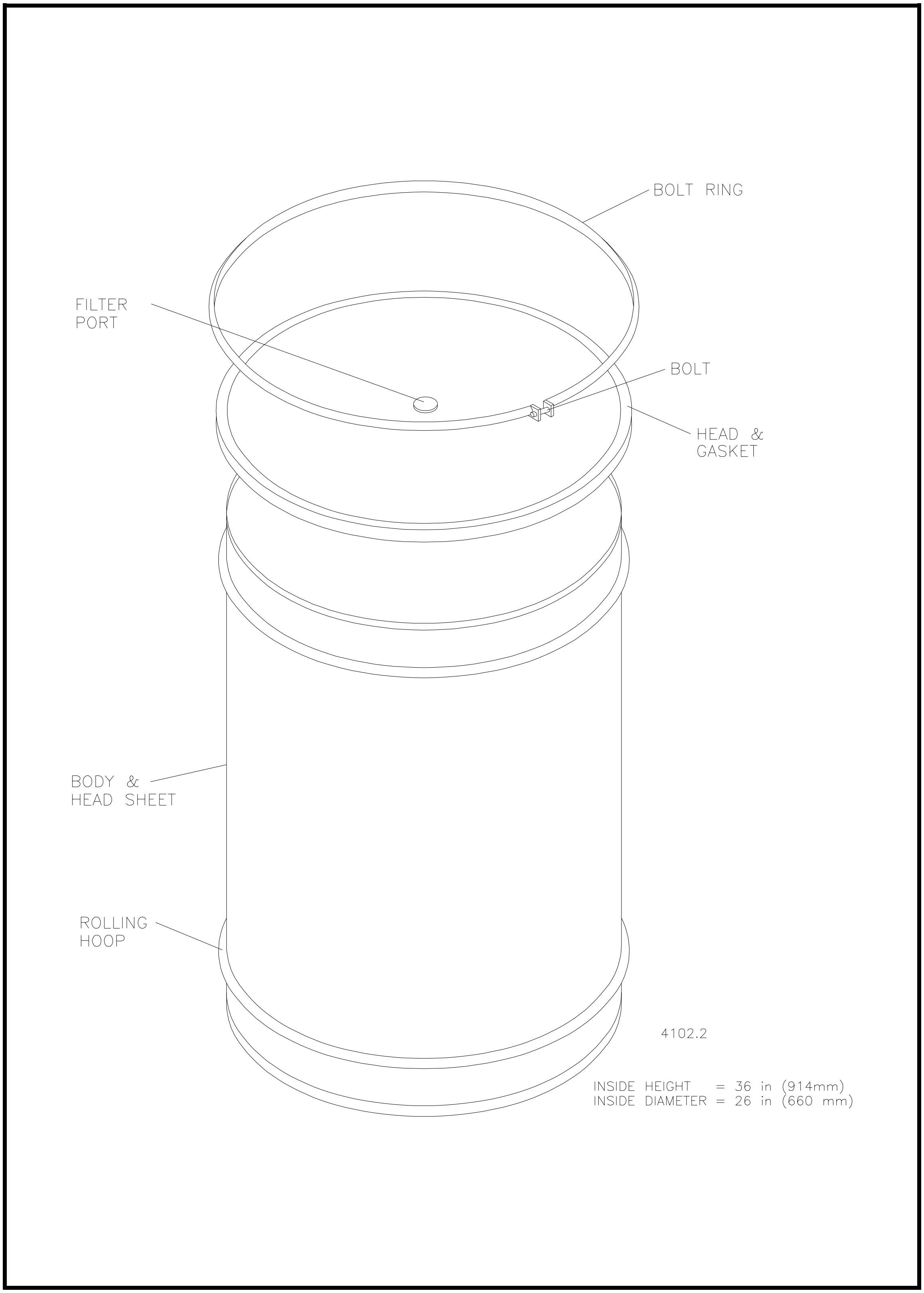

Figure 4.2-17, 85-Gallon Overpack

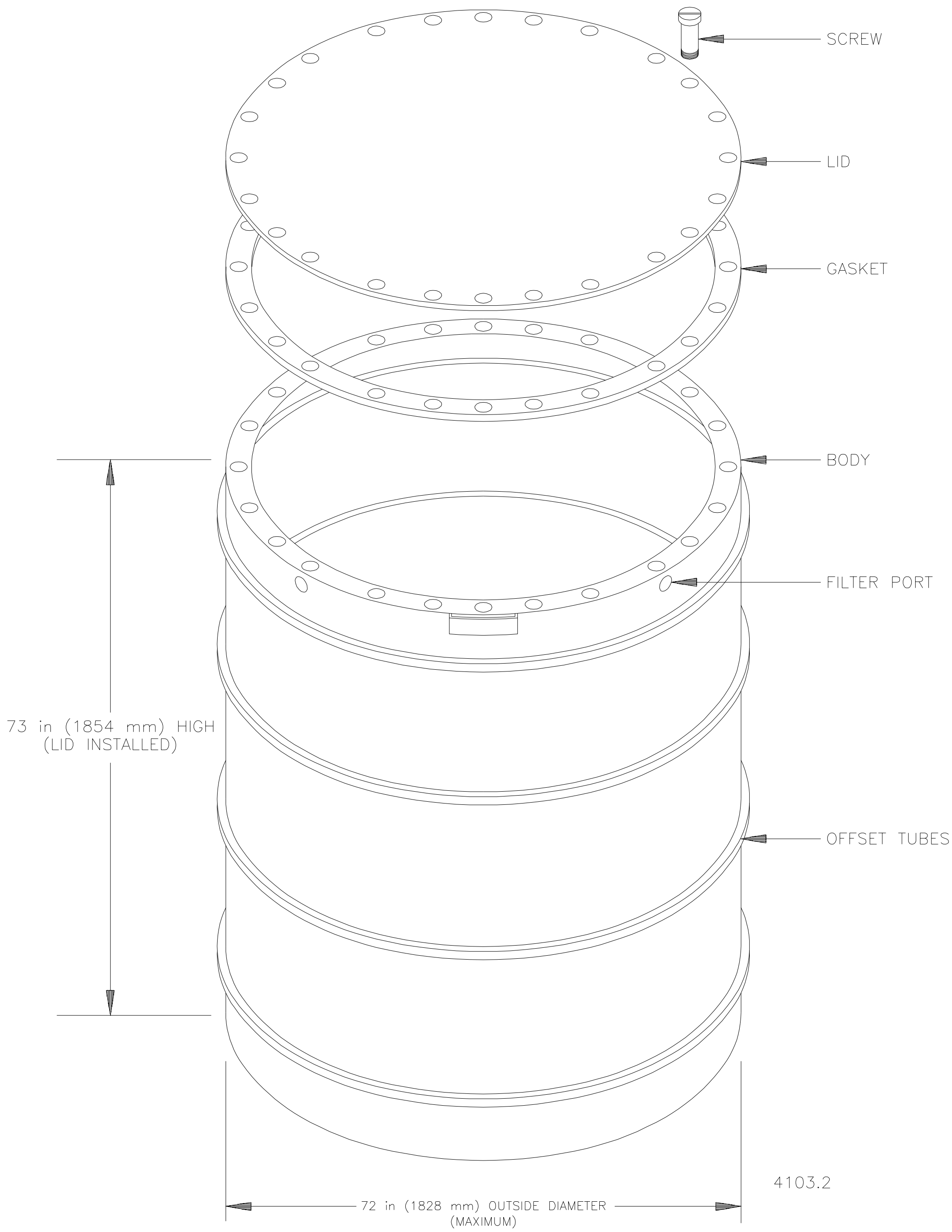

Figure 4.2-18, Ten-Drum Overpack

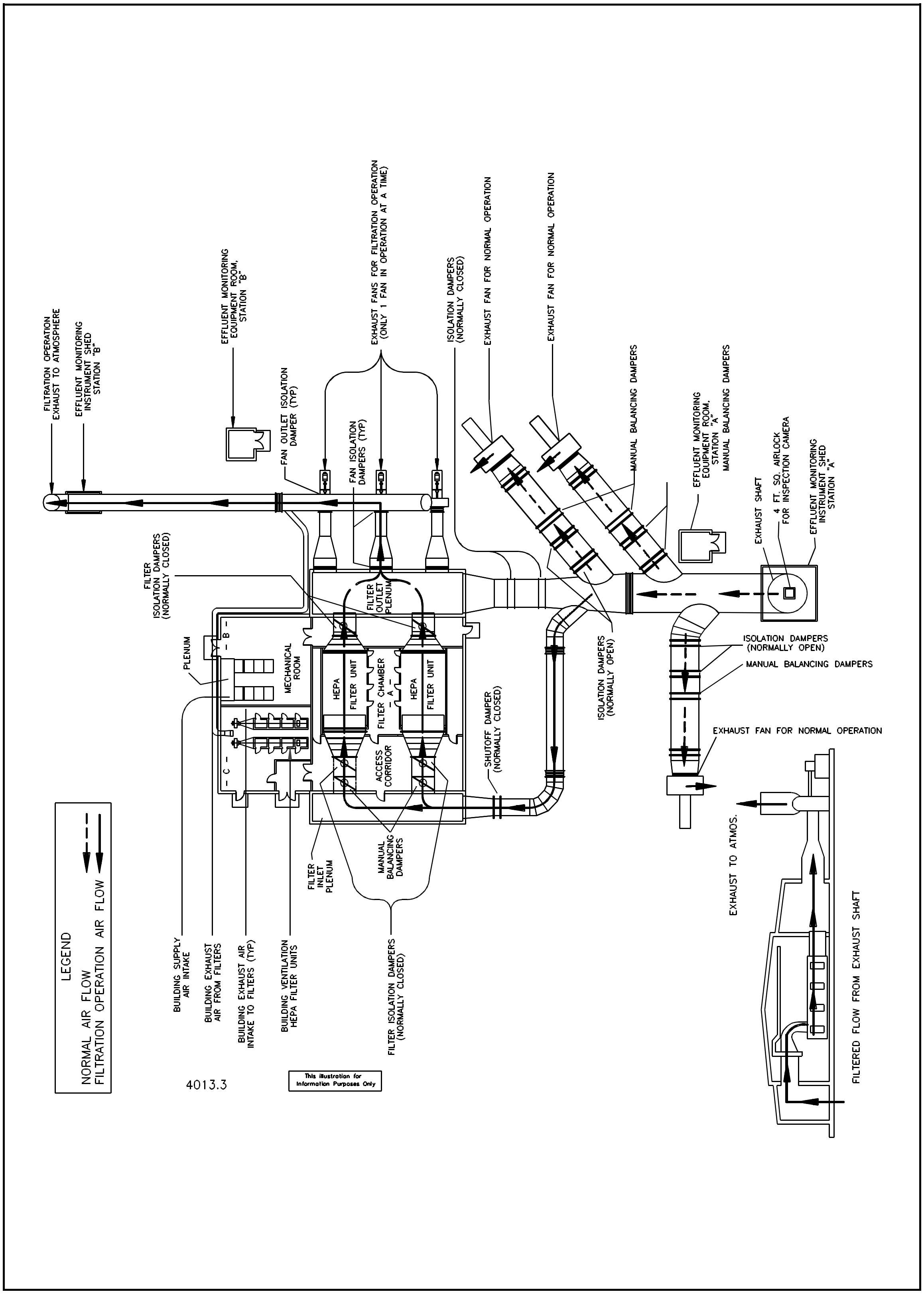

Figure 4.2-19, Exhaust Filter Building

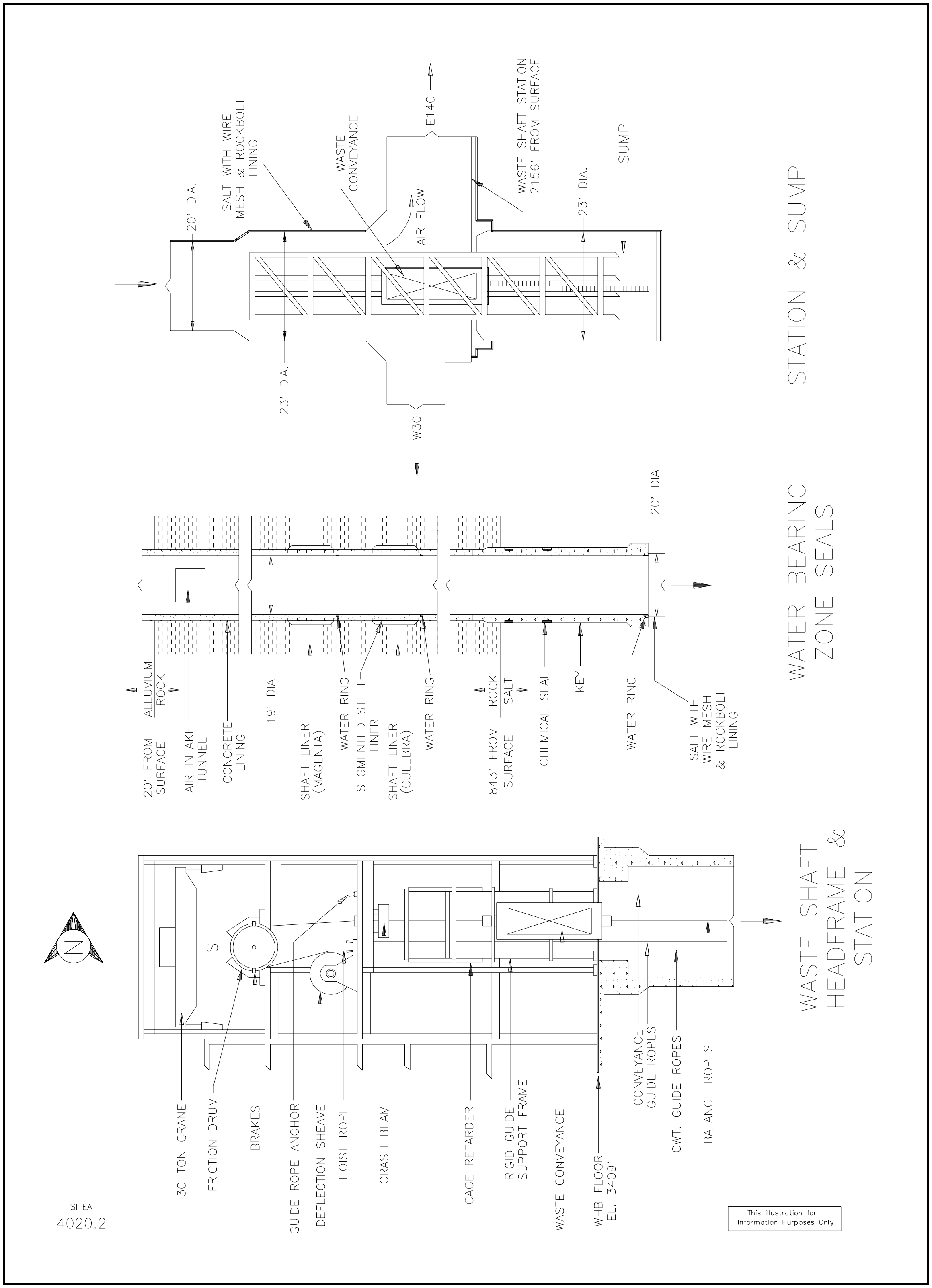

Figure 4.2-20, Waste Shaft and Hoist Arrangement

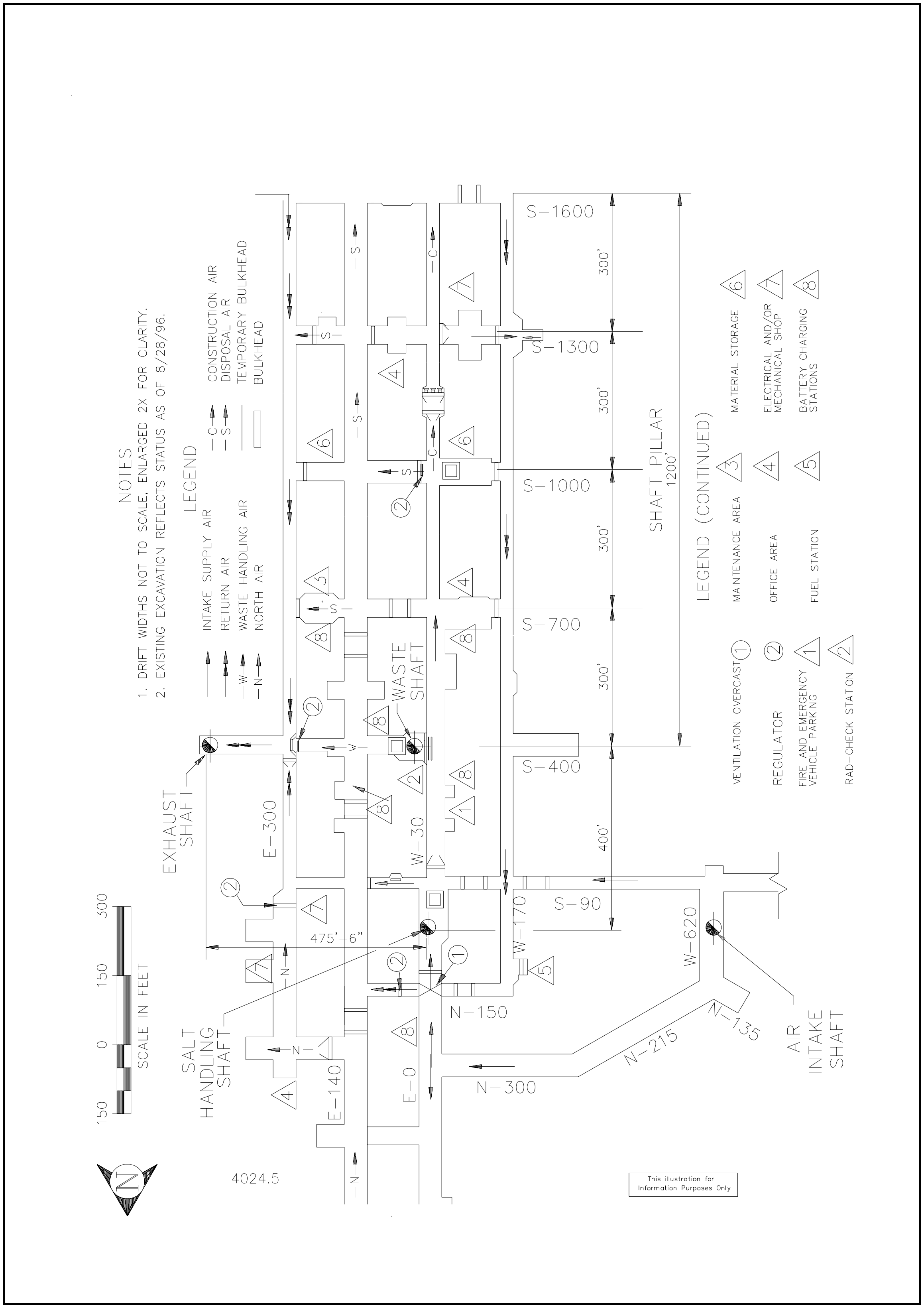

Figure 4.2-21a, Shaft Pillar Area Layout and Ventilation Flows

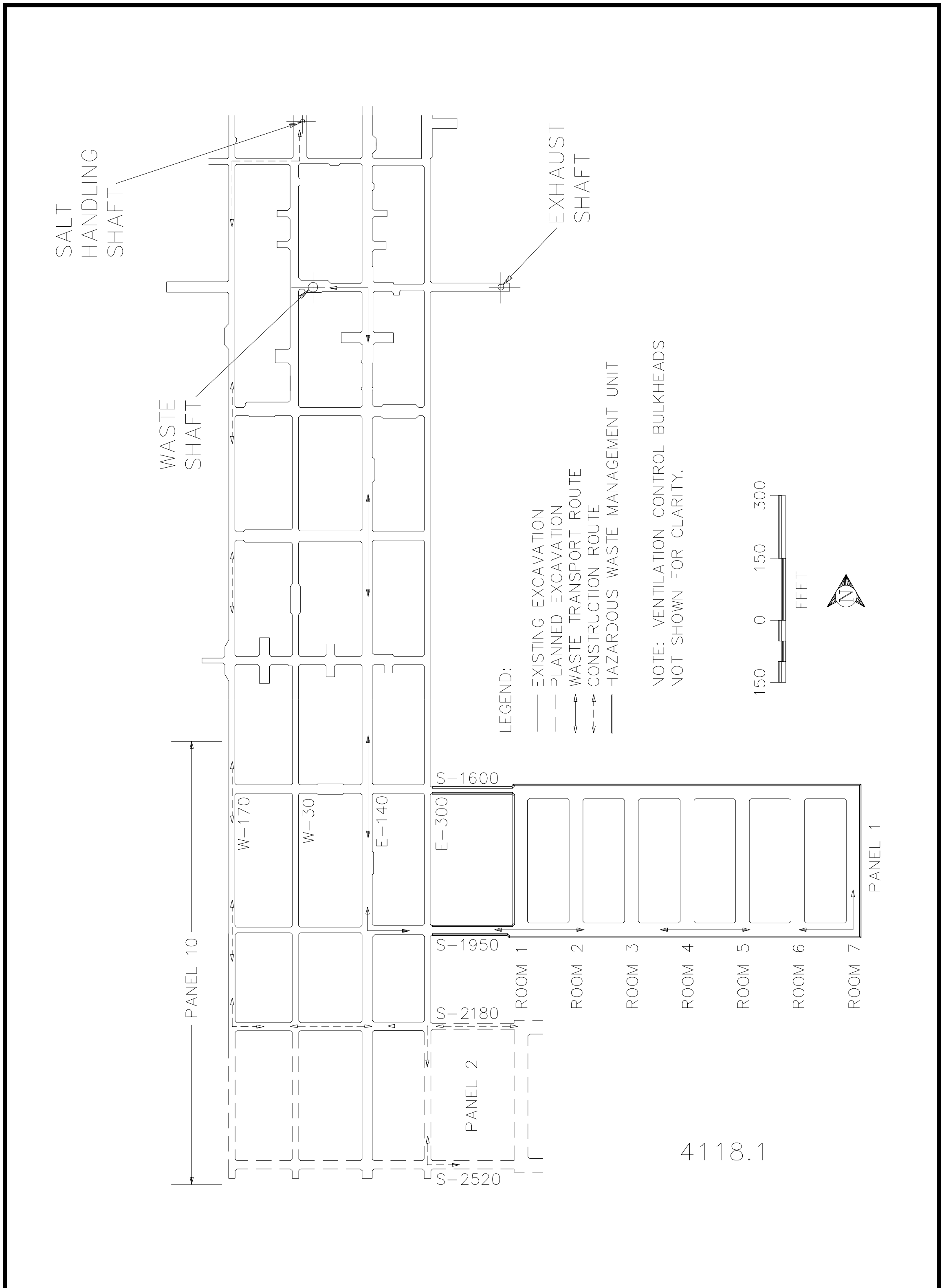

Figure 4.2-21b, Underground Transport Routes

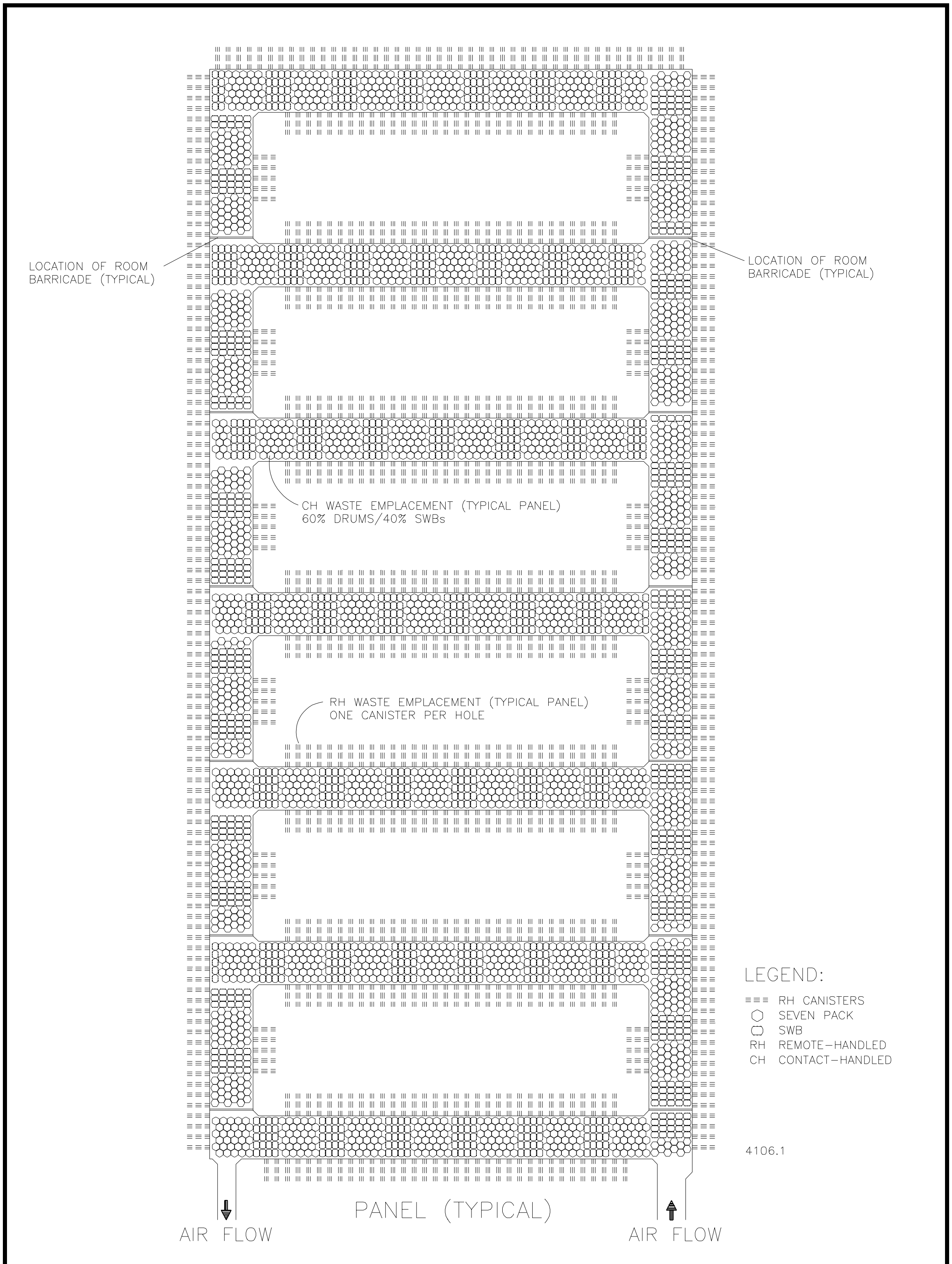

Figure 4.2-22, Typical RH and CH Transuranic Mixed Waste Disposal Configuration

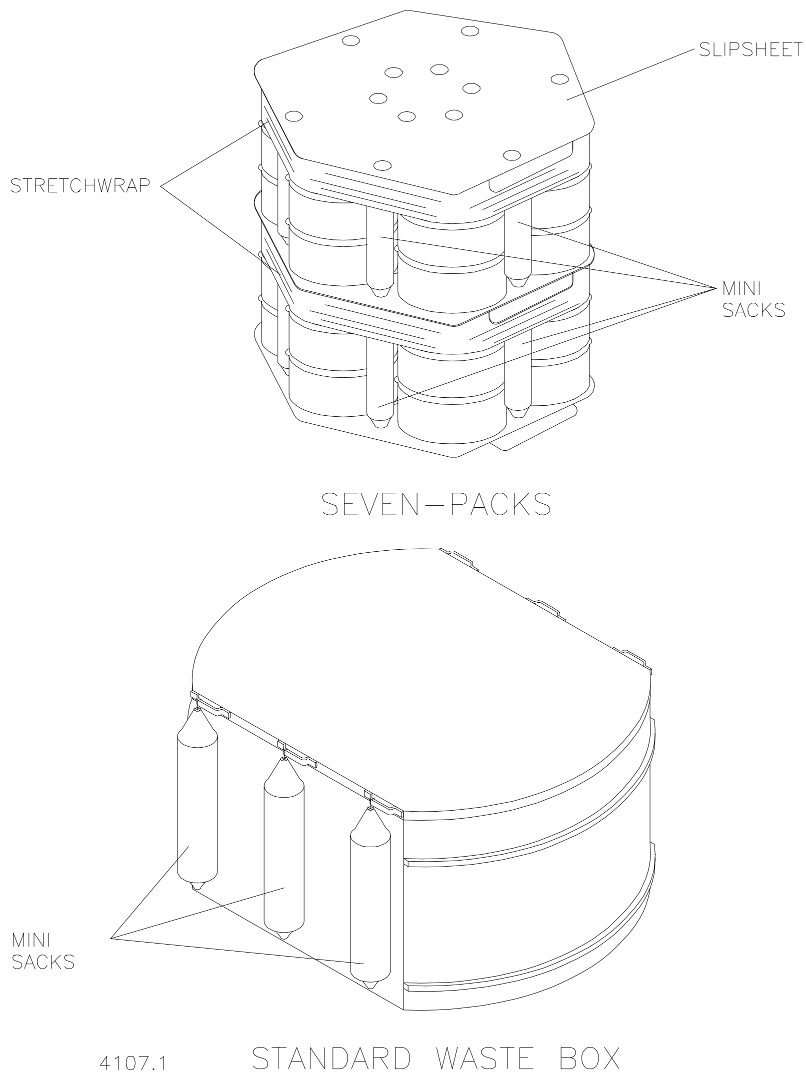

Figure 4.2-23, Waste Containers with Mini Sacks Attached

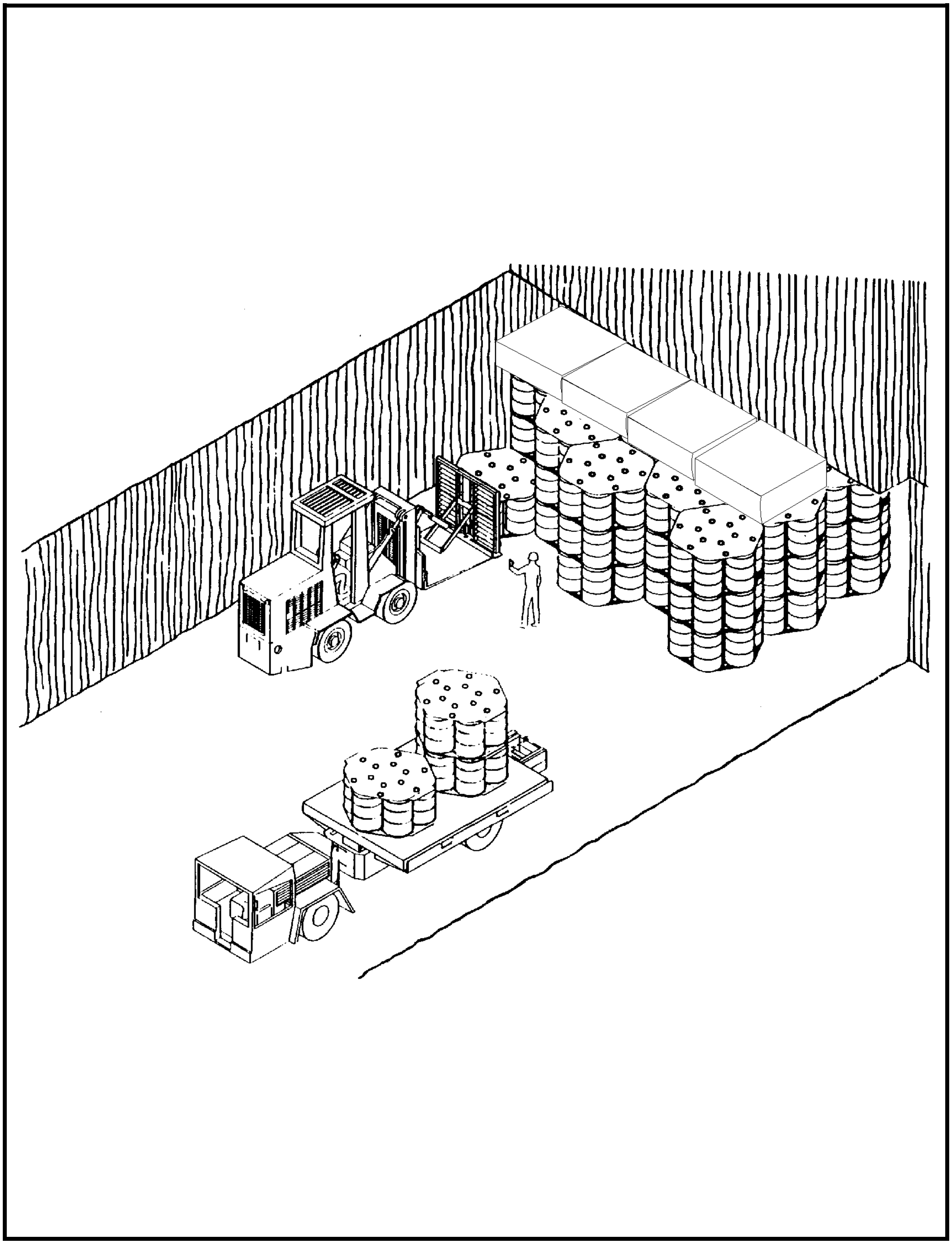

Figure 4.2-24, Backfill Emplaced in a Room

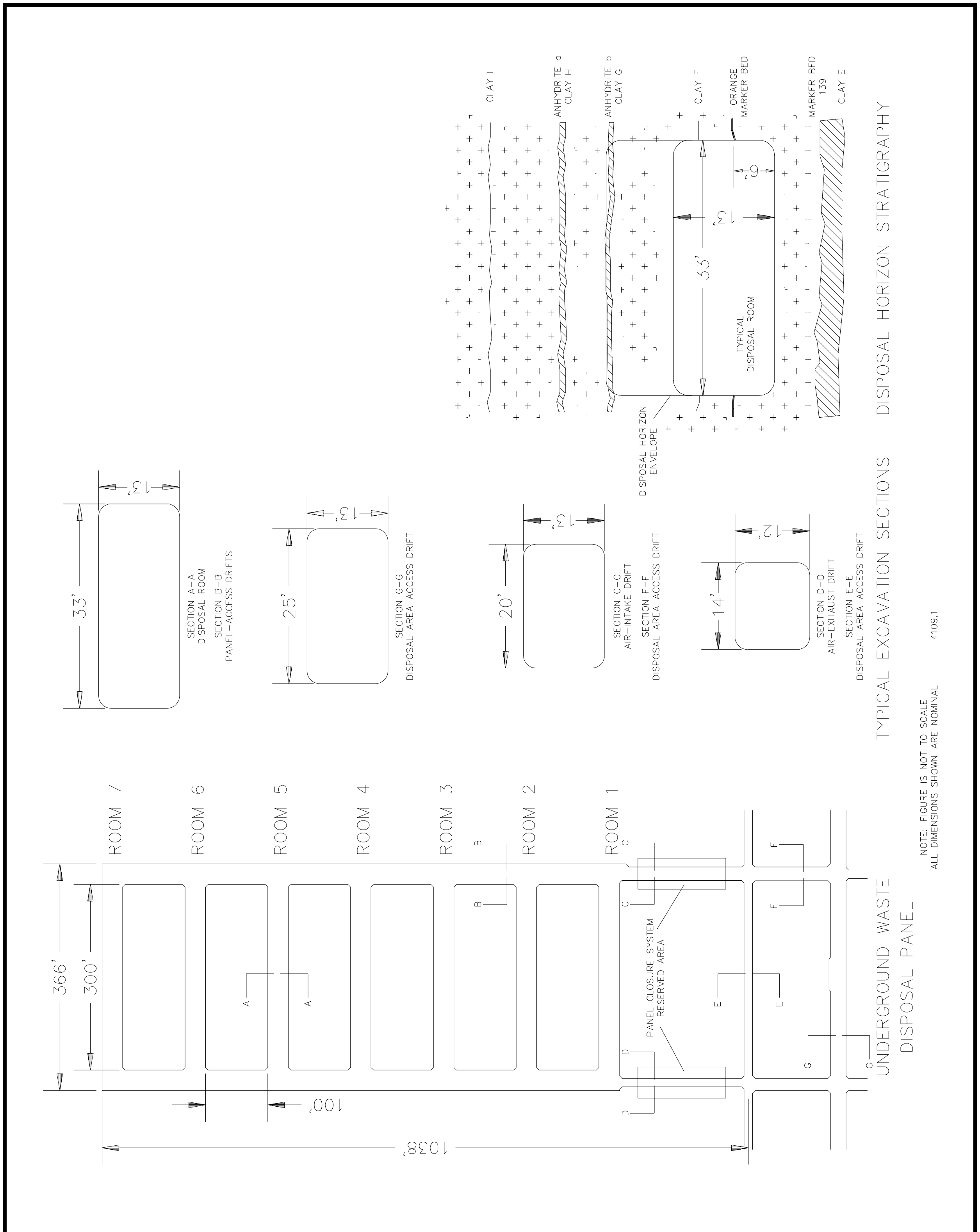

Figure 4.2-25, Typical Disposal Panel

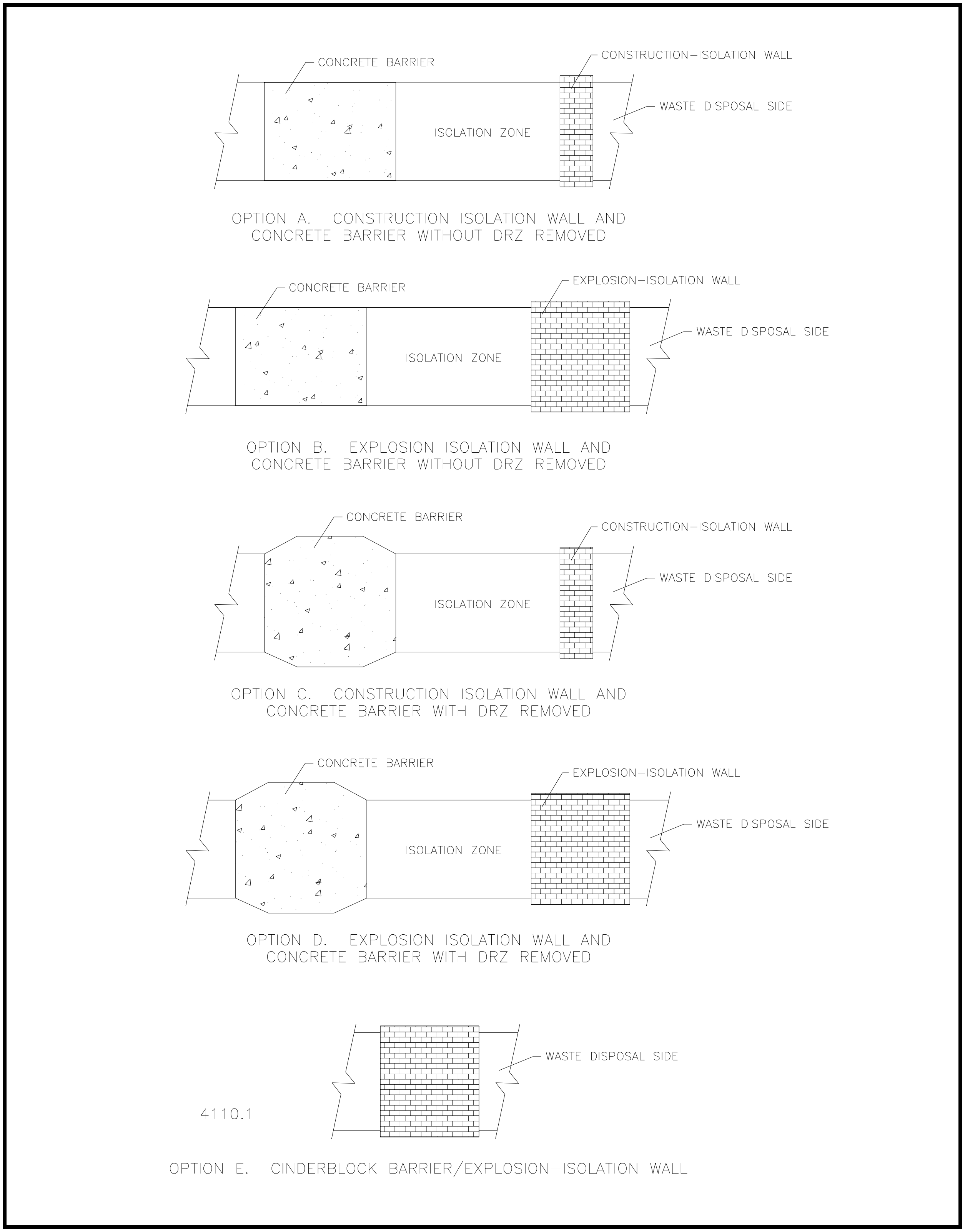

Figure 4.2-26, Design of a Panel Closure System

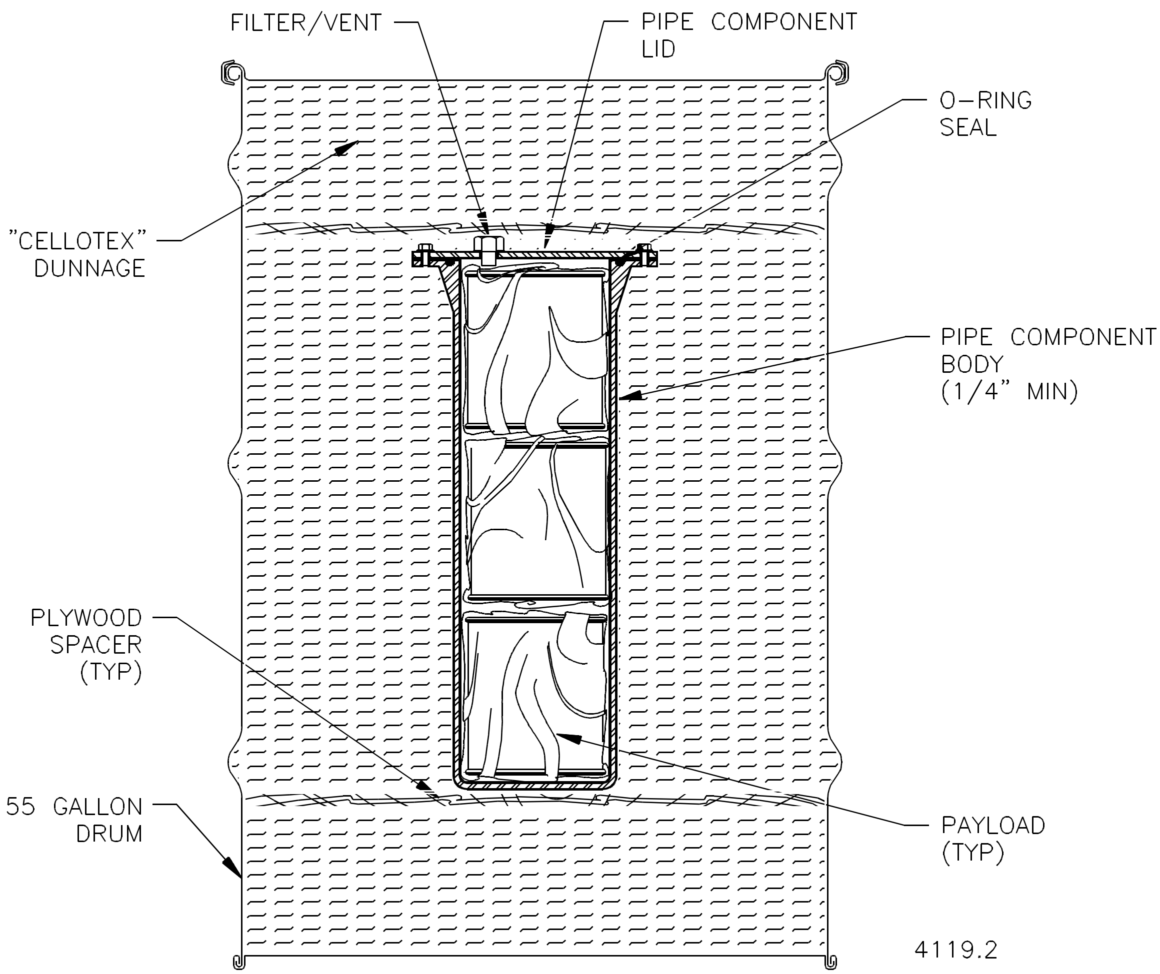

Figure 4.2-27a, Pipe Overpack

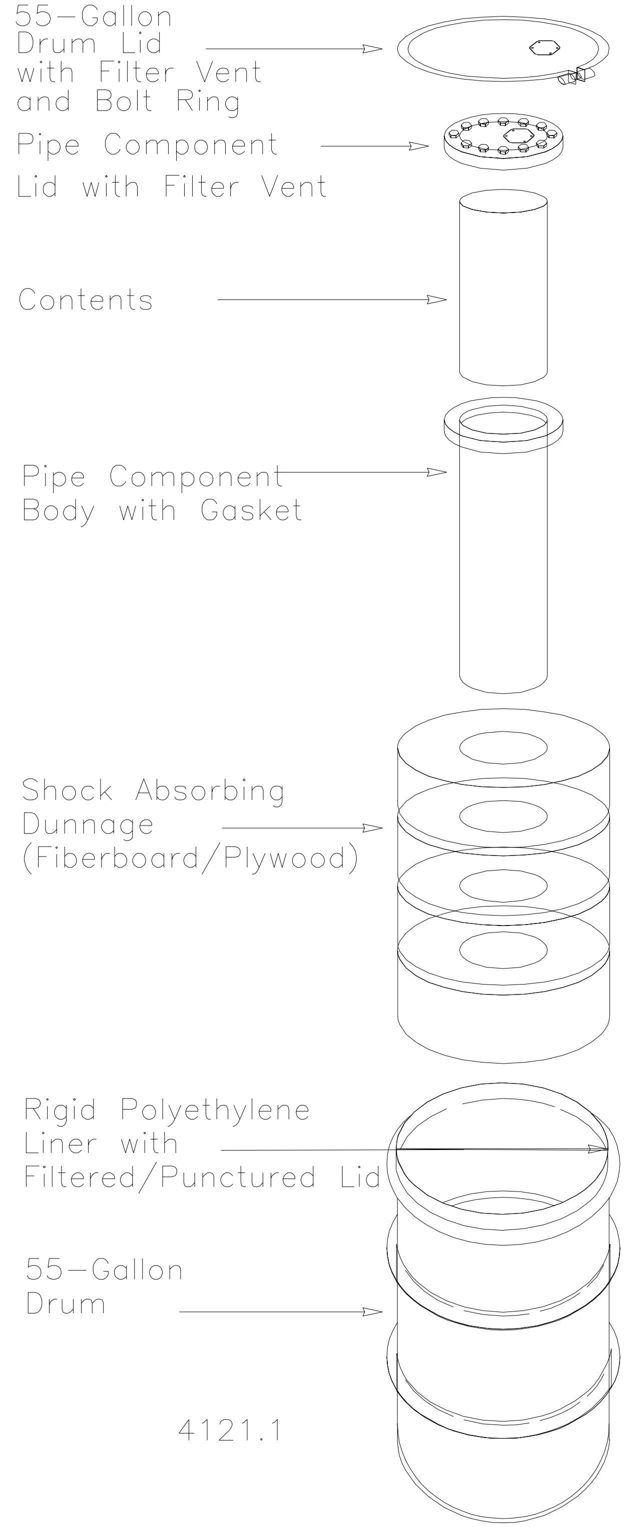

Figure 4.2-27b, Pipe Overpack

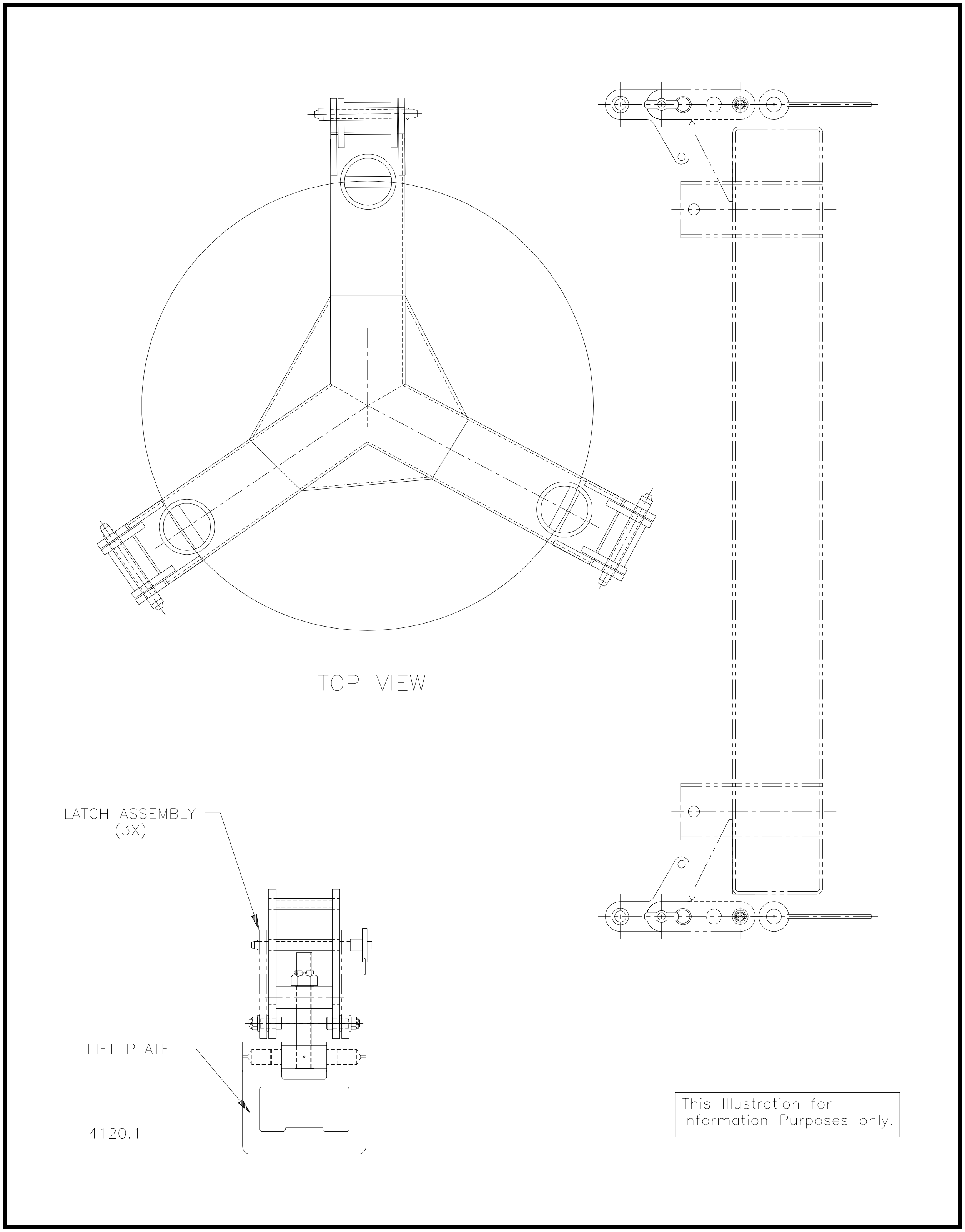

Figure 4.2-28, Ten Drum Overpack Lift Fixture Adaptor

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4.3 Process Description

This section describes the processes and systems in place for handling CH and RH TRU waste at the WIPP facility. Process descriptions begin at the gate of the WIPP facility where CH TRU and RH TRU waste will arrive by truck. Rail shipments are not addressed at this time since they are not a current shipping mode. Descriptions of the transportation system are beyond the scope of the SAR.

This chapter addresses WIPP facility operation relative to design bases (e.g., 35-year operational life, design disposal capacity and throughput, etc). Process descriptions in this chapter are independent of the actual quantity of waste handled.

CH TRU process procedures are included in the WIPP WP 05-WH Waste Handling Operations Procedures.[1]

4.3.1 CH TRU Waste Handling System

The function of the CH TRU waste handling system is to receive the TRUPACT-II shipping packages bring them into the WHB, remove and inspect the waste containers, and move the containers to the underground disposal area. A flow diagram of the operations sequence is shown in Figure 4.3-1. TRUPACT-IIs (Figure 4.3-2) are shipped to WIPP using special trailers (Figure 4.3-3). The CH TRU loading/unloading dock area, accessed by any of three air locks, consists of two TRUDOCKS, each capable of staging two TRUPACT-IIs, for unloading.

4.3.1.1 CH TRU Waste Receiving

Each shipment is inspected; inspection includes verifying the shipment documentation, performing a security check, and conducting an initial radiological survey of the shipment as it arrives on the site. If any levels of radiation, contamination, or significant damage in excess of acceptance criteria are found, actions will be taken in accordance with the approved procedures.

Following turnover of the shipping documentation, the driver transports and parks the trailer, unhooks the transporter either outside the CA in the security yard receiving area, or inside the CA at one of the trailer staging positions. The driver is subsequently released. If outside the CA, the disconnected trailer is attached to a yard tractor and brought into the CA by operations personnel for placement to be unloaded. Final external contamination surveys are performed in the CA. After unloading, empty TRUPACT-IIs are loaded on the trailer and returned to the security yard receiving area following radiological surveys and release.

The TRUPACT-IIs are unloaded from trailers outdoors in the CA using 13-ton electric forklifts, transported through an air lock designed to maintain differential pressure in the WHB, and placed in a vacant TRUDOCK. Electric forklifts are used to minimize the impact of diesel exhaust particulates on the WHB HEPA filters. The physical arrangement and location of the air locks and TRUDOCKS are described in Section 4.2, and each air lock is sized to accommodate a TRUPACT-II on a 13-ton electric forklift.

4.3.1.1.1 CH Bay

After entry into the WHB, the TRUPACT-II is placed in a TRUDOCK, the container opened, and the waste containers removed (Figure 4.3- 4). Before the waste containers are removed from the TRUPACT-II, radiological surveys are conducted on all accessible surfaces. As the containers are removed, further radiological surveys are conducted.

The outer lid tamper seal is first removed. The outer lid is removed (If required, a vacuum is applied to the outer lid vent port to compress the lid toward the vessel body, enabling the locking ring to rotate, unlocking the lid. During this process, the atmosphere between the inner lid and outer lid is vented through industrial grade HEPA roughing filters). The underside of the outer lid and top of the inner lid are surveyed for contamination. The outer lid is removed and placed in an adjacent lay-down area with the aid of a 6-ton overhead bridge crane and specially designed lifting fixture. The vacuum pull process is repeated for the inner lid. The only difference is that a radiological assessment filter is attached to the vent port tool, upstream of the industrial grade HEPA roughing filters. The inner cavity atmosphere is vented first through the radiological assessment filter and then the industrial grade HEPA roughing filters. The radiological assessment filter is subsequently checked for radioactive contamination. The TRUDOCK Vent-Hood System (TVHS) is attached to the inner containment vessel (ICV) lid, and the lid raised. The TVHS provides atmospheric control and confinement of headspace gases at their source. It also prevents potential personnel exposure and facility contamination due to the spread of radiologically contaminated airborne dust particles, and minimizes personnel exposure to volatile organic compounds (VOC). The air from the vent hood is monitored by an alpha CAM prior to passing through an in-line industrial grade HEPA filter system. The air is then released to the WHB return air ducts. Functionally, the TVHS consists of 1) vent-hood assembly, 2) industrial grade HEPA filter assembly, 3) fan to provide forced airflow, 4) ductwork, and 5) a flexible hose.

Prior to moving the lid aside, contamination surveys under the vent hood are performed on the inner lid and accessible waste container surfaces. If no contamination is detected, the vent hood is removed, and the ICV lid set aside using the same overhead bridge crane and lifting fixture. Additional contamination surveys are performed on the waste containers. If no contamination is detected, the overhead 6-ton crane is used to remove and transfer the TRUPACT-II payload to the prepositioned facility pallet. A typical TRUPACT-II contains fourteen 55-gallon (208 L) drums that are stretch wrapped or banded together into two seven-packs. Each seven-pack, or assembly, sits on a molded slip sheet that is made of high molecular density polyethylene or kraft board (cardboard). A second slip sheet is placed on top of the seven-pack, and the entire assembly is held together by stretch wrap or steel banding.

Final contamination surveys are conducted, and the waste container identification numbers are recorded using a bar code reader system for transfer to the inventory tracking system. For inventory control purposes, TRU mixed waste container identification numbers will be verified against the shipping documentation. Inconsistencies will be resolved with the generator before TRU mixed waste is emplaced. If inconsistencies cannot be resolved, the TRUPACT-II and waste containers will be shipped back to the generator/storage site. Waste awaiting the resolution of discrepancies will be stored in the storage area located in the southeast corner of the CH Bay. The loaded facility pallet is transported, using a 13-ton electric forklift, to the northeast area of the CH bay for normal storage. This storage area, which is shown in Figure 4.3-5, will be clearly marked to indicate the lateral limits of the storage area. A maximum capacity of seven pallets (1,441 ft^3 [40.8 m^3]) of waste may be stored in the normal storage area and the TRUDOCK area combined during normal operations (Figure 4.3-5).

The pallets will typically be staged in the normal storage area prior to downloading to the disposal area.

Aisle space will be maintained in all CH Bay waste storage areas. The aisle space will be adequate to allow unobstructed movement of fire-fighting personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space of 44 in. (1.1 m) between facility pallets will be maintained in all CH TRU waste storage areas.

In addition, four TRUPACT-IIs, may occupy the staging positions at the TRUDOCK. If waste containers are left in the TRUDOCK area, they will be in the TRUPACT-II shipping package or on facility pallets. The volume of waste in four TRUPACT-IIs is 411.7 ft^3 (11.7 m^3).

A derived waste storage area is shown in Figure 4.3-5 on the north wall of the CH Bay. This area will contain containers up to the volume of a SWB for collecting derived waste from all waste handling processes in the WHB. The DOE is permitting this area so that containers in size up to a SWB can be used to accumulate derived waste. Using a SWB facilitates safer, easier, and more efficient handling of filled derived waste containers. The volume stored in this area will be up to 65.4 ft^3 (1.85 m^3). A 3-ton electric forklift is used for general purpose transfer operations. This forklift has attachments and adapters to handle individual CH TRU waste containers, if required.

Normal operations for receipt and emplacement of seven-packs of drums containing CH TRU waste do not include removal of empty drums received as dunnage in the seven-pack. Seven-packs consisting entirely of empty drums will be dispositioned in the most cost-efficient manner (returned to the generator site, scrapped, etc.).

After the waste containers are removed from the TRUPACT-IIs, a final radiological survey and maintenance inspection are performed on the package, and the unit is prepared for reuse and removal from the WHB. This is accomplished by a series of inspections, and by replacing the pallets and container closures. The TRUPACT-II is reloaded on a trailer and prepared for departure to a shipping site.

4.3.1.1.2 Shielded Holding Area

An area has also been designated for the temporary storage of waste containers for which manifest discrepancies were noted after the TRUPACT-IIs were opened. Discrepant payloads will either be placed onto a facility pallet or placed back into the TRUPACT-II and placed into the Shielded Storage Room (also known as Shielded Holding Area). The storage capacity of this area is one pallet load (i.e., 4 SWBs, 2 TDOPs, or 28 drums, or combinations of all three). If discrepancies cannot be resolved within 30 working days, the waste will be returned to the generator site.

Use of this area is in accordance with the WIPP WP 05-WH Waste Handling Operations Procedures.[1]

4.3.1.1.3 Conveyance Loading Room

The conveyance loading room is an air lock adjacent to the waste shaft. A pallet of waste containers is moved by forklift into this air lock and placed on the conveyance loading car. The conveyance loading car (Figure 4. 2-14) is an electrically driven car on rails, designed with an adjustable-height flat bed used to transfer the CH TRU facility pallets on or off the pallet support stands located in the waste hoist cage. With the outer air lock door closed, the conveyance loading car moves the pallets on the hoist cage and transfers the pallets to the pallet support stands in the waste hoist cage. The waste hoist cage (or conveyance) operating in the waste shaft is a multi-rope, friction type hoist, and has inside dimensions of 9 ft (2.7 m) by 15 ft (4.6 m) by 24 ft (7.3 m) high. Normally, one facility pallet (two TRUPACT-II loads consisting of 28 drums, four SWBs, or two TDOPs) will be carried at a time. Finally the hoist lowers the waste containers to the disposal horizon. Personnel may be carried on the upper deck when waste is not being hauled.

4.3.1.1.4 CH TRU Waste Shaft Station

At the waste shaft station, the underground waste transporter backs up to the waste hoist cage, and the pallet is pulled onto the integral tractor trailer transporter (Figure 4.3- 6). The tractor is a commercially available, diesel-powered unit modified as necessary to interface with the trailer, and comply with mine and other safety codes. The trailer is designed specifically for transporting palletized CH TRU waste and is sized to accommodate the CH TRU facility pallet (Figure 4.3- 7). The transporter then moves the waste containers to the waste disposal room. Underground transporters are equipped with fuel tanks resistant to rupture, and speed governors to minimize the potential consequences of underground accidents. As shown in Figure 4.2-21b, the separation of the excavation and transport routes removes the potential for collisions with the underground transporter along the waste transportation route. No other vehicles will be moving in the waste transport route while moving waste in the underground.

4.3.1.1.5 CH TRU Waste Disposal Area

At the waste disposal room, the waste containers are removed from the transporter using diesel and battery powered CH TRU waste underground lift trucks, and stacked in the disposal face. The lift trucks are equipped with push/pull rack attachments and specially designed fixtures to lift and move individual seven-packs, single drums of waste containers (drums), TDOPs, or SWBs. Seven-packs, single drums, TDOPs, and SWBs are stacked in such a manner that the criticality Technical Safety Requirements (TSR) administrative controls are not violated (Figure 4.3-8a). Drums, boxes, and TDOPs are intermixed, as practical and for stability; overpack containers in four-pack assemblies are always placed on the top row of the waste stack, TDOPs are placed on the bottom row (Figure 4.3-8b). After the waste containers are removed from the facility pallets and the TRUPACT-II pallets, these pallets are returned to the surface for reuse.

The waste will be emplaced room by room in Panels 1 through 8. Panels 9 and 10 may also be used to reach the full authorized capacity of 6.2 million ft^3 (175,600 m^3). Each panel will be closed off when filled. If a waste container is damaged during the Disposal Phase, it will be immediately overpacked or repaired. CH TRU waste containers will be equipped with filter vents. The filter vents will allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations.

Panel construction may occur during the waste emplacement. Once a waste panel is mined and any initial ground control established, flow regulators will be constructed to assure adequate control over ventilation during waste emplacement activities. The first room to be filled with waste will be Room 7, which is the one that is farthest from the main access ways. The disposal phase will begin with CH waste only in Panel 1. When combined CH and RH operations begin, the first activity in the appropriate room will be to drill RH TRU emplacement holes into the ribs. Once this is complete, the RH drilling machine will be moved to next lower number (7 to 6, or 6 to 5, etc.) room. A ventilation control point will be established for the Room just filled, outside the exhaust side of the next Room (Figure 4.3-9a). This ventilation control point will consist of a bulkhead with a ventilation regulator. The initial waste emplacement activity in the panel will be the placement of RH canisters in the predrilled holes in the ribs. Each room and associated access drifts will hold approximately 90 canisters of RH waste. Once RH emplacement is completed, CH emplacement will commence.

Stacking of CH waste will begin at the ventilation control point and proceed down the access drift, through the room and up the intake access drift until the entrance of next room is reached (Figure 4.3-9b). At that point, a fire resistant, Mine Safety and Health Administration approved, brattice cloth and chain link barricade (Figures 4.4-8 and 4.4.-9) will be emplaced. This process will be repeated for the remaining rooms, and so on (Figures 9a through 9e) until the panel is filled (Figure 4.3-10). At that point, the panel closure system will be constructed.

The anticipated schedule for the filling of each of the underground Panels 1 through 8 is as follows. The following assumptions are made in estimating the time to fill each panel:

- Throughput for CH waste is 784 drums per week (7 pallets per day, 4 days per week, 28 drums per pallet).

- The capacity of a panel is 81,000 drums.

Under these assumptions, a minimum of 104 weeks is needed to emplace the waste. Allowing a 25 percent contingency for maintenance delays and time to transition from one room to another, it is estimated that a panel will be filled 2.5 years after emplacement is initiated. Panel closure in accordance with the Closure Plan in Chapter I, RCRA, Part B Permit Application[3] is estimated to require an additional 150 days.

4.3.2 RH TRU Waste Handling System

The RH TRU waste handling system, including each function, the equipment used, and the operations performed, is discussed in this section. A schematic flow diagram of the RH TRU handling is given in Figure 4.3-11, and a pictorial view of the surface operation is given in Figure 4.3-12. The RH TRU waste handling area is designed to provide for an outdoor storage area and space exists to store six RH TRU waste trailers.

The RH TRU waste shielded road cask (shipping container) is a legal weight DOT Type B truck cask designed to transport a single canister of RH TRU waste per shipment. The cask provides two levels of containment and will be certified by the NRC per 10 CFR 71.63(b). Stainless steel is the primary structural material used for the inner and outer vessels. The outer vessel incorporates lead shielding to assure the surface radiation levels are below DOT limits. The general road cask arrangement, shown in Figure 4.3-13, includes impact limiters at each end of the road cask which function to provide protection of the seal areas during the hypothetical transport accident events.

The RH TRU waste handling system is designed to overpack up to two percent of the canisters handled at the WIPP facility.

4.3.2.1 RH TRU Waste Receiving

Each incoming shipment is inspected, the inspection process checks the shipment manifest, verifies the shipment contents, performs a security check, and performs an initial exterior radiological survey of the shipment as it arrives on the site. If any levels of radiation, contamination, or significant damage in excess of acceptance criteria are found, actions will be taken in accordance with the waste handling operations procedures.

The two impact limiters are removed from the road cask while still on the trailer. With the impact limiters removed, the gross weight of the loaded road cask is 20 tons. Overall dimensions of the shielded road cask with the impact limiters removed are a diameter of 42 in (107 cm) and an overall length of 142 in (361 cm). A bridge crane engages the shielded road cask and rotates it to the vertical position for subsequent transfer to the road cask transfer car. The crane has a main hook capacity of 140 tons and a 25-ton auxiliary hook. Other equipment includes load measuring devices capable of measuring 150 percent of capacity, and a handling yoke for upending and lifting the shielded road cask.

4.3.2.1.1 Road Cask Preparation

The road cask preparation area includes the road cask transfer car with an integral work platform, where the road cask is prepared for unloading. The road cask transfer car (Figure 4.3-14) is an electrically powered, tracked vehicle for supporting and transferring the shielded road cask between the road cask preparation area and the road cask unloading room of the WHB. The road cask transfer car incorporates position sensors that stop car travel when the cask is centered under the shielded road cask unloading room port of the hot cell in preparation for cask closure removal.

The outer closure is removed using appropriate radiological surveys for surface contamination and radiation level.

The shielded road cask inner closure bolts are loosened and the shielded road cask seal collar is installed. Radiological monitoring is required for these and subsequent operations that call for personnel to work in direct contact with the loaded road cask.

4.3.2.1.2 Road Cask Unloading

The shielded road cask, mounted on the road cask transfer car, is moved to the road cask unloading room and positioned under the hot cell unloading port which mates with the shielded road cask seal collar. At this point, personnel leave the area and close the shield door.

4.3.2.1.3 Hot Cell Canister Handling

Inspection of the RH TRU waste canisters occurs in the hot cell. The hot cell is an exclusion area when canisters of RH TRU waste are present, and any reentry after RH TRU waste handling requires a radiological survey of the cell area. The hot cell area has its own 15-ton capacity bridge crane and grapple for canister handling inside the cell, and handling operations are performed in the following sequence:

- The shield plug between the hot cell and the road cask unloading room is removed from the hot cell floor and placed in the hot cell laydown area.

- The inner cask head is then lifted into the hot cell and placed in the laydown area.

- A seal protector is installed on the shielded road cask from the hot cell.

- The canister is lifted from the shielded road cask and moved to the hot cell inspection station.

- The inspection station contains the equipment holding the canister in a vertical position. Manipulators are used to swipe the canister and the swipes are removed using the shielded transfer drawer to check for contamination. If the canister is contaminated or physically damaged, the canister is placed in an overpack and the overpack head placed on the unit and welded. Upon completion of the overpack operation, the overpack is swiped to determine contamination level.

- The canister is transferred to the canister transfer cell.

4.3.2.1.4 Canister Transfer Cell and Facility Cask Loading Room

The canister is transferred from the hot cell to the shuttle car in the canister transfer cell. The canister shuttle car (Figure 4.3-15) is a long, rail-mounted, electric-powered car located in the canister transfer cell and designed to transfer waste canisters from the port in the floor of the hot cell to the port in the floor of the facility cask loading room. The shuttle car has a capacity for seven canisters, one of which can be overpacked and can be used for temporary canister storage or movement of the canisters to the facility cask loading room. Remote controlled closed circuit television (CCTV) cameras are used to monitor operations in the very high radiation area when canisters are present. The following steps are performed:

- The canister shuttle car is moved to position an empty tube directly under the hot cell shield valve and then the hot cell/canister transfer cell shield valve is opened.

- Using the crane and grapple, the canister is removed from the inspection station and lowered into the canister shuttle car, the grapple is retracted, and the shield valve closed. The canister shuttle car is moved to position the canister directly under the facility cask loading room shield valve.

- The facility cask (Figure 4.3-16) is a double end loading shielded container designed to transfer one RH waste canister at a time from the facility cask loading room to the disposal location. The shielded road cask has two gate-type shield valves for loading and unloading canisters using the hoist in the facility cask loading room, and the RH TRU waste emplacement machine during emplacement. The front trunnion is used to rotate and hold the shielded road cask in the horizontal or vertical position, as required. The facility cask is positioned horizontally on the facility cask transfer car in the facility cask loading room and as the facility cask is moved into position over the loading port, a rotating fixture engages the upper trunnions and rotates the shielded road cask to a vertical position.

- The telescoping shield is raised to mate with the facility cask and the facility cask loading room shield valve is opened. The shield bell is mated with the upper shield valve on the facility cask and both facility cask shield valves are opened.

- The loading room grapple is lowered through the facility cask into the canister transfer cell where the grapple engages the canister lifting pintle of the canister positioned under the loading port and lifts the canister into the facility cask.

- The facility cask lower shield valve and the facility cask loading room shield valve are then closed, the telescoping shield is retracted, and the canister is lowered on the lower facility cask shield valve. The grapple is disengaged and retracted into the shield bell, the upper facility cask valve closed, and the shield bell is raised from the facility cask into its storage position.

- As the facility cask transfer car is moved toward the waste hoist, the facility cask rotates from a vertical to a horizontal position and the rotating device is disconnected. The facility cask and facility cask transfer car move on the waste hoist cage.

4.3.2.1.5 Waste Shaft Entry Room

In the waste shaft entry room with the waste hoist cage properly positioned, the shaft gates are opened, the pilot rails are positioned, and the facility cask and facility cask transfer car are loaded on the waste hoist cage. The hoist cage is lowered to the disposal horizon. The facility cask and facility cask transfer car are moved to the underground transfer area (Figure 4.3-17).

4.3.2.1.6 Transfer Area

In this area the facility cask is removed from the facility cask transfer car by forklift and moved to the disposal room.

4.3.2.1.7 RH TRU Waste Disposal

The underground handling and emplacement equipment consists of diesel-powered forklifts, and a horizontal emplacement and retrieval machine. The RH waste handling equipment is the largest equipment transporting waste in the waste disposal area and therefore defines the minimum operating sized opening of 11 ft (3.35 m) vertical and 14 ft (4.3 m) horizontal for waste handling transport.

A horizontal hole has been drilled in the disposal room for canister emplacement. The RH TRU waste emplacement and retrieval machine interfaces with the forklifts and facility cask, and an alignment fixture is utilized to establish alignment of the emplacement equipment with the borehole (Figure 4.3-18 through Figure 4.3-22). The alignment fixture is positioned by forklift to locate the shield collar in line with the drilled hole. The leveling jacks are adjusted until the fixture is at the proper elevation and parallel to the longitudinal axis of the hole.

The facility cask is then positioned by forklift on the emplacement machine bed which ensures that the cask is accurately located on the emplacement machine (Figure 4.3-20). The facility cask is moved forward to mate with the shield collar and the transfer carriage is advanced to mate with the rear facility cask shield valve. The shield valves are opened and the transfer mechanism advances to push the canister into the hole (Figure 4.3-21). After retracting the transfer mechanism into the facility cask, the forward shield valve is closed, and the transfer mechanism is further retracted into its housing. The transfer carriage is moved to the rear about 6½ ft (2 m) and the shield plug carriage containing a shield plug is placed on the emplacement machine. The transfer mechanism is used to push the shield plug into the facility cask. The front shield valve is opened and the shield plug is pushed into the hole (Figure 4.3-22) completing the process.

The transfer mechanism is retracted, the shield valves closed on the facility cask, and the facility cask removed from the emplacement machine. After all the equipment is removed from the hole, a stop bar is mounted over the installed shield plug and canister. The emplacement machine is now available for transfer to another location.

4.3.3 Process Interruption Modes

General waste handling systems of the WIPP facility are described in Section 4.3.1 and Section 4.3.2. Process interruption modes are discussed in this section and fall into two categories: routine and emergency.

4.3.3.1 Routine Interruptions

Routine interruptions are plant process interruptions, including scheduled maintenance, unscheduled maintenance, and plant inspections during the life of the facility.

Actions taken during an interruption are conducted in accordance with established procedures, and monitoring of the plant parameters during the interruption is continued to ensure that no radiological problems are encountered. Any additional surveillances that are necessary during the interruption are specified in the procedures.

Under normal operations, removable surface contamination on the shipping package or the waste containers will not be in excess of the DOE's free release limits (i.e., 20 disintegrations per minute (dpm) alpha or 200 dpm beta/gamma per 100 cm^2). In such a case, no further decontamination action is needed. The shipping container and waste container will be handled through the normal process. However, should the magnitude of contamination exceed the free release limits, yet still fall within the criteria for small area (spot) decontamination (i.e., less than or equal to 100 times the free release limit, and less than or equal to 6 ft^2 [0.56 m^2]), the shipping container or the waste container will be decontaminated. In addition, if during the waste handling process at the WIPP, a waste container is breached, it will be overpacked or decontaminated as needed. Should WIPP structures or equipment become contaminated, waste handling operations in the affected area will be immediately suspended.

All decontamination operations will be performed under the controlled conditions of a Radiological Work Permit (RWP) and the standard operating procedures found in the WIPP WP 12-HP Operational Health Physics series Procedures.[2] Decontamination activities will use water and cleaning agents so as to not generate any waste that cannot be considered derived waste. Items that are radiologically contaminated are also assumed to be contaminated with the hazardous wastes that are in the container involved in the spill or release. A complete listing of these waste components can be obtained from the WIPP Waste Identification System (WWIS), for the purpose of characterizing derived waste.

Written procedures specify materials, protocols, and steps needed to put an object into a safe configuration for decontamination of surfaces. A RWP will always be prepared prior to decontamination activities. TRU mixed waste products from decontamination will be managed as derived waste. The DOE had previously proposed use of an Overpack and Repair Room to deal with major decontamination and overpacking activities. The DOE has eliminated the need for this area by: 1) limiting the size of contamination events that will be dealt with as described in this section, and 2) by performing overpacking at the point where a need for overpacking is identified instead of moving the waste to another area of the WHB. This strategy minimizes the spread of contamination.

Small area (spot) decontamination will occur at the TRUDOCK or other locations where contamination is detected. Overpacking would only occur in the event the WIPP staff damages an otherwise intact container during handling activities. In such a case, a radiological boundary will be established, inside which all activities are carefully controlled in accordance with the WIPP WP 12-HP Operational Health Physics series Procedures[2] protocols for the cleanup of spills or releases. A plan of recovery will be developed and executed, including overpacking the damaged container in either a 85-gal (321 L) drum, SWB, or a TDOP. The overpacked container will be properly labeled and sent underground for disposal. The area will then be decontaminated and verified to be free of contamination (essentially, this is done with "swipes" of the surface for counting in sensitive radiation detection equipment).

In the event a large area contamination is discovered on a TRUPACT-II during unloading, the waste will be left in the TRUPACT-II and the shipping package will be resealed. The DOE considers such contamination problems the responsibility of the shipping site. Therefore, the shipper will have several options for disposition. These are as follows:

- The TRUPACT-II can be returned to the shipper for decontamination and repackaging of the waste. Such waste would have to be re-approved prior to shipment to the WIPP.

- The TRUPACT-II may be shipped to another DOE site for management in the event the original shipper does not have suitable facilities for decontamination. If the repairing site wishes to return the waste to WIPP, the site will have to have Waste Acceptance Criteria (WAC)[4] certification authority and would have to re-certify the new shipment.

- The waste could go to a third (non-DOE) party for decontamination. In such cases, the repaired shipment would go to the original shipper and be recertified prior to shipment to the WIPP.

4.3.3.2 Emergency/Abnormal Interruptions

Emergency interruptions are those process interruptions in the plant due to accident conditions, which include earthquakes, severe weather emergencies, and fires.

<u>Earthquake Interruptions</u> - Normal plant operations may be suspended following an earthquake. If the earthquake is of sufficient magnitude (i.e., seismic event of 0.015 g or greater acceleration), inspection of structures and equipment will be required prior to resuming normal operations. The length of the interruption will depend upon the results of the inspection and all plant recovery corrective actions will be directed toward returning the plant to normal operation.

<u>Severe Weather Emergencies</u> - Normal plant operations may be suspended during a tornado warning or a high wind condition. A tornado warning or high wind condition will exist based on information provided by the National Weather Service or a local observation. If a severe weather emergency condition occurs at the WIPP facility, inspections of structures and equipment may be required prior to resuming normal operations. The length of the interruption will depend on the results of the inspection, and all plant recovery corrective actions will be directed toward returning the plant to normal operation.

Fires - Fire accidents, although not expected, may result in a process interruption. The occurrence of a major fire requires the evacuation of personnel and response by appropriate emergency personnel. After extinguishing the fire, the area will be surveyed, controls will be established to mitigate any problems, and the area returned to normal operations.

Abnormal Interruptions are any unplanned and unexpected change in a process condition or variable adversely affecting safety, security, environment, or health protection performance sufficient to require termination (stopping or putting on hold) of an operating procedure related to the flow path of radioactive waste processing for greater than four hours.

Loss of Off-Site Power - The loss of off-site power affects all electrical equipment. The plant is designed with a manually started backup power supply, which picks up selected electrical loads such as the AIS hoist, lighting, and ventilation system. Certain equipment has uninterruptible (battery) backup for loss of power so that functions such as parts of the central monitoring system (CMS) continue without power interruption. The site backup power system can maintain the containment functions (e.g., negative pressure ventilation balance), and is discussed in Section 4.6.

4.3.4 WIPP Waste Information System

The WIPP WAC[4] requires specific information from the waste generators to meet the waste certification requirements. The WIPP waste information system (WWIS) provides an online source of data required by the WAC,[4] showing the waste form, packaging, weight, and radionuclide inventory.

The WIPP WWIS is a system of computerized tools in a multiuser relational database designed to facilitate the effective management and tracking of TRU waste from DOE waste generator sites to the WIPP. The WWIS will gather, store, and process information pertaining to TRU waste designated by the Secretary of Energy for disposal at the WIPP. The system will support those organizations who have responsibility for managing TRU waste by collecting information into one source and providing data in a uniform format that has been verified or certified as being accurate. The WWIS will be a reliable, secure, and accurate system to store all information pertaining to characterization, certification, and emplacement of waste at WIPP. Waste information for WWIS will be supplied by the generator sites of the TRU waste and the WIPP facility.

The WWIS includes features to automate the transfer of the data required by the WAC[4] from the waste generators to the WIPP and also includes the limiting criteria from the WAC[4] summarized in Chapter 3. Data input by the waste generators that does not meet these criteria is automatically flagged for review. In addition to providing WAC[4] related information for the repository, the WWIS provides operational information, and routine and special reports. See WP 05-WA.06[5], Appendix A for an example of the WWIS Data Dictionary .

The WWIS provides the following primary functions:

- Entry and validation of waste characterization data for waste destined for the WIPP.
- Entry and validation of waste certification data for waste destined for the WIPP.
- Entry and validation of waste transportation data for waste destined for the WIPP.
- Entry and validation of waste emplacement location data for waste emplaced at the WIPP.

During the waste handling process, the waste container bar code is entered into the WWIS to track the location of the waste, and to verify that the information contained in shipping documents was correct. Once the waste is emplaced, a final set of documents summarizing the contents and final disposition of the waste is generated by the WWIS and added to other pertinent documentation to create the required records. The records generated will be used to show WIPP's compliance with the applicable regulations relative to the type of wastes destined for disposal at WIPP.

4.3.4.1 CH TRU Waste Emplacement

For inventory control purposes, waste container identification numbers are checked against the data in the WWIS at the time the waste is unloaded. The underground disposal location for each waste container is entered at the time the waste is placed in the disposal array.

4.3.4.2 RH TRU Waste Emplacement

The identification number of each RH TRU waste canister is verified against the data container while the canister is in the hot cell.

4.3.5 Underground Mining Operations

4.3.5.1 Mining Method

Mining is performed by continuous mining machines. Prior to mining in virgin areas, probe holes are drilled to relieve any pressure that may be present. After mining, vertical pressure relief holes are drilled up at the main intersections of drifts and crosscuts.

One type of continuous mining machine is a roadheader or boom type continuous miner operating a milling head. The milling head rotates in line with the axis of the cutter boom, mining the salt from the face. The mined salt is picked up from the floor by the loading apron. The muck (mined salt) is pulled through the miner on a chain conveyor, through a slewing conveyor, and then loaded in one of the haul vehicles.

Another type of continuous mining machine is a drum miner operating with a head that rotates perpendicular to the axis of the cutter boom, and cuts the salt away from the working face. The muck is pulled through the miner on a chain conveyor and then loaded in one of the haul vehicles.

During and immediately after mining, a sounding survey of the roofs of drifts is made to identify areas of drummy or slabby rock, which might represent safety or stability problems. A comprehensive underground safety and maintenance program has been established and can be found in the WIPP WP 04-AU1007, Underground Openings Inspections.[8]

Remedial work, including hand scaling of thin drummy areas, removal of larger drummy areas up to 18 in thick with the continuous miners, or rock bolting, is accomplished immediately after soundings in any areas identified as potentially unstable. Additional scaling is performed, as required, using a mechanical scaler, improving the safety of this operation.

Rock bolts are used extensively throughout the underground openings for remedial work and for safety. In addition, roofs in the first waste disposal panel and high traffic areas are pattern bolted for extra safety. Both resin and mechanical bolts are used in most ground control activities. Only certified bolts are used at the WIPP; the specifications in References 8 and 9 are used in defining bolting requirements for the underground.

The WIPP engineering staff is responsible for ensuring that ground control systems comply with all rules and regulations.

4.3.5.2 Interface Between Mining and Waste Disposal Activities

Separate mining ventilation and disposal ventilation circuits are maintained by means of temporary and permanent bulkheads. Air pressure in the mining side is maintained higher than in the disposal side to ensure that any leakage results in airflow to the disposal side. The underground ventilation system is discussed in Section 4.4.2. Rooms being mined are within the mining ventilation circuit, and rooms under disposal are within the disposal ventilation circuit.

4.3.5.3 Mined Material

The salt removed during underground mining is brought to the surface by the salt handling system. From the surge pocket, salt is loaded into the 8-ton salt handling skip with a skip measuring and loading hopper, the skip is raised to the surface, and dumped through a chute to surface haulage equipment which transports the salt to an on-site storage pile.

4.3.5.4 Ground Control Program

The WIPP facility ground control program ensures underground safety from any potential unplanned roof or rib falls. Care is taken from the moment a drift is mined and throughout the life of the opening to remove or restrain any loose or potentially unsafe pieces of ground. As the opening ages, areas of the roof, ribs, and floor may require some ground control. To ensure this is achieved in a timely and efficient manner, a very comprehensive ground control monitoring program has been established.

<u>Ground Control Planning</u>

An internal ground control operating plan is used to guide both short and long-term planning. For the purpose of ground control activities, the underground facility at the WIPP site is divided into over 100 zones. These zones facilitate detailed evaluation and documentation of the status and conditions of the underground. A database has been developed which documents the current status of each ground control zone. The current status refers to the physical state of an underground excavation (zone) with respect to geometry, excavation age, ground support, and operational use. The data collected for the plan and the evaluation of those data are most useful when used or considered immediately after collection. Detailed work packages are developed specifically for each ground control activity. The plan also serves as a foundation document for the development of the Long-Term Ground Control Plan.[6]

The Long-Term Ground Control Plan[6] provides a strategy for development and selection of the most applicable and efficient means of maintaining and monitoring the ground conditions of the WIPP in order to assure safe and operational conditions from the present time to closure of the facility. The plans for the most current years covered by the plan are explained in more detail than the later years, since it is easier to predict the immediate future than the distant future. The Long-Term Ground

Control Plan[6] addresses technical aspects of the underground facility which are concerned with the design, construction, and performance of the subsurface structures and support systems. In particular, this plan addresses the requirement for maintaining the ground conditions in the underground facility in a safe and operational state for its anticipated lifetime.

Topics associated with the stability of the roof of the underground facility are the primary focus of the Long-Term Ground Control Plan.[6] During the period of time that the underground has been active, a variety of ground control issues have been encountered ranging from minor spalling to roof falls. Minor spalling is small pieces of the back flaking off or falling. The ground control program consists of many aspects which include continuous visual inspections of the underground openings, extensive geotechnical monitoring, numerical modeling, analysis of rockbolt failures, implementation of ground control procedures, and comprehensive in situ and laboratory testing and evaluation of ground control components and systems.

Each year the Long-Term Ground Control Plan[6] is rolled forward one year. This rolling revision takes into account developments in both WIPP and industrial support practices and materials, and any changes in WIPP life and operational requirements. WIPP ground control plans are living documents that keep ground control practice at WIPP both current and responsive.

Ground Control Practice

A comprehensive ground control program for the entire underground facility is followed at WIPP to ensure safe conditions, operational efficiency, reliability and confidence, and regulatory compliance for personnel and equipment.

Qualified and experienced personnel in Geotechnical Engineering, Mine Engineering, and Underground Operations are responsible for and committed to the success of this program. The elements of the program are monitoring; initial and on-going evaluation; engineering design and specification; data collection and analysis; implementation; and maintenance as necessary. These elements include the following main activities.

- Monitoring: The geotechnical performance of the underground facility is regularly evaluated by the Geotechnical Engineering section. This evaluation is focused to provide early detection of conditions that could affect safety and operations, and to permit further engineering analysis of the performance of WIPP excavations in salt. At present there are over 1,000 instruments installed underground, and additional instruments are installed as conditions warrant. Daily and weekly visual examinations are performed by Mine Operations staff.

- Evaluation: Geotechnical and mining engineers then perform a variety of rock mechanics analyses to ensure that rock mass behavior is correctly understood and proper ground control measures are instituted from the beginning.

- Engineering Design and Specification: The ground support system is designed and specified to ensure the safety of staff and to facilitate operations. Maintenance activities are specified in performance standards and procedures so that ground conditions presenting a potential hazard are safely rectified. Ground control problems are addressed on an individual basis so that the most appropriate method of remediation is implemented. Geotechnical Engineering is constantly improving ground support systems in order to provide the most effective and safe methods and materials possible for the underground facility

- Data Collection and Analysis: Field activities are established for data collection from geotechnical instrumentation, fracture and excavation effect surveys, and general observations. Ground conditions are examined on a regular basis (at the beginning of each shift, weekly, monthly, and annually according to regulatory requirements and operating plans). Monitoring results are analyzed in comparison with established design criteria, and are utilized in a variety of computer models. The results of these studies are published in a variety of formats ranging from specific reports through frequent regular assessments (e.g., bi-monthly summaries) to comprehensive annual reports (e.g. Geotechnical Analysis Report), which are available to the public in reading rooms. All data and related documentation are maintained in databases which are regularly subjected to quality assurance audits. These data are available to those who make independent assessments.

The fundamentals on which the ground control program at the WIPP facility are based are as follows:

- Ground stability is maintained as long as access is possible.
- Ground control maintenance efforts increase with the age of the openings.
- Ground control plans are specific but flexible.
- Regular ground control maintenance is required.

The ground control program at the WIPP facility uses observational experience and analysis of salt behavior underground to enable various projections regarding future ground support requirements. This approach recognizes that salt moves or creeps. Because of its plastic nature, salt will flow into an excavated opening. To provide long-term ground support, the ground control system must:

- Accommodate the continuous creep of salt.
- Retain broken fractured rock in the back or rib.

Two major categories for support systems are rock bolts and supplementary systems. The rock bolt systems are mechanically-anchored bolts and resin-anchored threaded rods. The supplementary systems include cables with mesh, trusses, and the Room 1, Panel 1 design.

Initial Roof Support System (Rock-Bolt System)

Prior to waste emplacement in any specific area (room), the plans (for Panels 2-8) are to spot bolt with short, mechanically anchored bolts only as necessary, if spalls or loose ground are encountered during and after the mining process. Mesh may be used in conjunction with these bolts to secure any loose ground encountered during normal inspection processes. These bolts would not penetrate through to the next clay/anhydrite interface, and would be anchored within the beam formed by the mine roof and the clay/anhydrite interface above. This is the primary or initial support which will be used in Panels 2-8.

However, based on experience with the Site and Preliminary Design Validation (SPDV) rooms and the rooms in Panel 1, pattern bolting is not expected to be required until 2-5 years after excavation. Disposal rooms may be pattern bolted prior to waste emplacement. The expert panel convened to study Panel 1 in 1991 concluded that the then current support technology of 10 ft (3.05 m) long mechanical bolts used in Panel 1 should be adequate to ensure stability for 7 to 11 years from the time of excavation. These bolts were installed beginning approximately two years after initial excavation on a pattern described as a 5 ft by 5 ft (1.5 m x 1.5 m) offset pattern (one bolt per 25 ft^2 [2.3 m^2]). Experience in Panel 1 confirms the conclusion of the expert panel. Plans call for bolt systems installed in future bolt patterns to be equal to or exceed the bearing characteristics of the mechanically anchored bolts used in the primary pattern in Panel 1.

The justification for choosing these systems includes their demonstrated ability to support the expected loads. In the case of yielding systems, they will be chosen based on their support capabilities and the ability to accommodate expected rock deformation.

Primary support will consist of Grade 75 steel mechanically-anchored bolts of at least 5/8 in. (1.6 cm) diameter. Depending on the need, the bolts may be as short as 24 in. (61 cm) and as long as 72 in. (183 cm). Mesh may be chain-link, welded wire, or polymer.

Pattern bolting will be designed using the best support technology available at the time. Because yielding systems are still under evaluation, current plans call for use of Grade 60 threaded bars of at least 7/8 in. (2.2 cm) diameter installed on a maximum 5 ft by 5 ft (1.5 m x 1.5 m) pattern in the center half of the room. The bars would be resin-anchored above the first clay/anhydrite interface. Four or 6 ft (1.2 or 1.8 m) long mechanical bolts would be used near the ribs.

Materials procured for installation as primary support, spot bolting, and pattern support will meet the requirements of 30 CFR 57, Subpart B.[9] This requirement will be verified as part of the quality assurance program. Primary support installation requires quality control by the installation crews. Proper installation is confirmed as part of the audit function of the underground safety and Quality Assurance groups. Quality control and assurance is more rigorous during a pattern bolting sequence. Work instructions for the sequence will require Quality Assurance to perform at least one random inspection to verify that material requirements and hole construction specifications are met. Operations (construction) supervisors will also be responsible for monitoring the construction. Finally, before turnover or completion of the installation, Quality Assurance will review the work, and certify their approval. Independently, MSHA inspectors also perform a Quality Assurance function during their frequent inspection visits to the WIPP, making certain that support construction is performed in accordance with 30 CFR 57, Subpart B.

Supplementary Support Systems

Similar to the plan for pattern bolting, any supplementary system will be designed using the best support technology available at the time. Should a supplementary support system be required, it is anticipated that, if not already in place, mesh will be installed over the primary and pattern support. The mesh will be augmented either by cables (wire ropes) anchored near the ribs and suspended across the rooms or by steel mats. The cables or mats and, therefore, the mesh will be further pinned to the roof by bolting. The use of either the cables or mats in conjunction with meshing and rebolting should be adequate in supporting even a highly fractured roof beam.

Support System Performance

Several distinct ground-support systems are installed in Panel 1. They can be generally grouped as rigid, non-yielding systems and yielding systems. Rigid, non-yielding systems are not designed to accommodate salt creep. However, they do respond to creep. and continue to provide support during ductile behavior. Based on experience with Panel 1, if Panels 2-8 are excavated and filled within five to seven years each, these non-yielding systems should provide the necessary support. If pattern bolting is performed just prior to waste emplacement in each room or area, experience at the WIPP has shown that these rigid systems can certainly accommodate the salt creep that will occur during the one to two years of emplacement.

The ground support system installed in Room 1, Panel 1 is a yielding system only as long as access can be maintained. This is because of the necessity to manually reduce the tension of the bolts. If the detensioning process is stopped, the system becomes a rigid, non-yielding system and will undergo the same ductile behavior as other rigid systems.

Other yielding systems are installed in the WIPP underground and each is still being evaluated. Each of these systems is designed to yield at predetermined loads. All are designed to work over their prescribed yield interval without maintenance. Some of the systems are designed to respond to the loading by salt creep and provide over one ft of yield without system degradation. A detailed evaluation of the adequacy of these systems is not possible at this time.

The initial roof support system, consisting of mechanical anchor bolts, was installed in 1988. The ground control design was developed based on information obtained from the SPDV rooms. Panel 1 rooms were pattern bolted with 10 ft (3.05 m) long, 3/4 in (19 mm) diameter, mechanical anchor bolts on a 3.0 ft (0.9 m) by 3.9 ft (1.2 m) center spacing through the middle third of each room. The outer third along each rib uses the same roof bolt but on a 3.9 ft (1.2 m) by 6 ft (1.8 m) center spacing pattern.

The original design for the waste disposal rooms at the WIPP provides a limited period of time during which to mine the openings and to emplace wastes. Each panel, consisting of seven disposal rooms, is scheduled to be mined and filled in less than five years, at which time it would be closed. Field studies, as part of the SPDV Program, showed that unsupported openings of a typical disposal room configuration would remain stable, and that creep closure would not impact equipment clearances during at least a five year period following excavation. The information from these studies verified that the design of openings for the permanent disposal of wastes under routine operations was acceptable.

Panel 1 was developed to receive waste for a demonstration phase that was scheduled to start in October 1988. The original plan consisted of the storage of drums of CH TRU waste in panel rooms for a period of 5 years. During this time and immediately following it, the rooms were to be inaccessible, but the option to reenter was to be maintained so that waste could be removed, if required. The demonstration phase was later deferred, and an experimental program was added in Room 1, Panel 1. This led to more stringent requirements for roof stability.

To ensure the roof stability for the revised tests and durations, a supplemental roof support system was designed. The Supplemental Roof Support System is designed to contain and support the weight of a detaching salt wedge of the immediate roof, if one begins to form, while allowing it to be deformed by creep behavior. The system is not designed to prevent the creep of salt into the room. The Supplemental Roof Support System consists of 26 steel channel support sets, installed laterally across the room on approximately 10 ft (3.05 m) centers. Each channel support set is carried by 11 resin anchored roof bolts. The bolts are anchored over the interval between 8.5 (2.6 m) and 11.5 ft (3.5 m)into the roof, which is above the expected failure surface. The roof area between the channel sets is covered by a network of steel wire lacing cables, which hold a mat of steel wire mesh and expanded metal against the rock salt surface.

The design of this system was subjected to exhaustive scrutiny by two formal Design Review Panels. The first review was conducted by qualified project personnel from the Westinghouse Waste Isolation Division (WID) Engineering, Operations, Quality Assurance, and Safety groups with the participation of SNL. A second formal review was conducted by a panel of rock mechanics experts not associated with the WIPP project. This Expert Review Panel consisted of representatives from the mining industry, U.S. Bureau of Mines, Mine Safety and Health Administration (MSHA), academia, and independent consultants. These Design Review Panels approved the design based on evaluation of design documents, on-site observations at the WIPP underground facility, and detailed discussions with members of the design team.

The support system is adjusted (Room 1, Panel 1 only) to ensure that the loads on the anchors do not exceed the working loads specified by the design. Support system monitoring results are used to determine when load adjustments (or other maintenance) are required. When the load on the bolt approaches 20,000 lbs (9070 kg), the bolts are adjusted to about 5000 lbs (2268 kg). Modifications were made to the support system to improve the reading accuracy of the monitoring system. This provided a better interaction between the rock and the support system.

A monitoring program for Room 1, Panel 1 has been in place since initial excavation of the room. Room stability has been assessed from monitoring of room closure, rock deformations in and around the room, and fracture development and separation. The deformation data collected by the monitoring system is then compared against previously acquired data to identify deviations from expected performance. This program has provided a great deal of information on support system performance, room and rock mass behavior, and ground control techniques and materials.

4.3.5.5 Geotechnical Monitoring

Geotechnical data on the performance of the repository shafts and excavated areas are collected as part of the geotechnical field-monitoring program. The results of the geotechnical investigations are reported annually. The report describes monitoring programs and geotechnical data collected during the previous year.

Instrumentation, Monitoring, and Evaluation

The WIPP geotechnical programs are conducted in accordance with written procedures, and provide in-situ data to support continuing assessments of the designs for the shafts and underground facilities. The safety of the underground excavations is, and will continue to be evaluated on the basis of criteria established from actual measurements of room behavior. These criteria are regularly evaluated and modified as more field data are collected, and additional experience is gained with the performance of the WIPP underground excavations.

Geotechnical monitoring programs provide measurement of rock mass performance for design validation, routine evaluation of the safety and stability of the excavations, and the short-term and long-term behavior of underground openings. The minimum instrumentation for Panels 2 through 8 is one borehole extensometer installed in the roof at the center of each disposal room. The roof extensometers will monitor the dilation of the immediate salt roof beam and possible bed separations along clay seams. Additional instrumentation may be installed as conditions warrant.

The evaluation of the performance of the excavation is performed by Geotechnical Engineering. These evaluations will provide an assessment of the effectiveness of the roof support system and an estimate of the stand-up time of the excavation. If the trend is toward adverse (unstable) conditions, the results of these assessments are reported to the Operations Manager to determine if it is necessary to terminate waste disposal activities in the open panel.

Data collection, analyses, and evaluation criteria ensure that geotechnical monitoring results provide timely indications of changes in measured room closure rates over time, and when those measured room closure rates exceed projected values. Closure rates are compared to projected values based on statistical evaluations of closure data that are updated annually. Areas with observed rates which significantly vary from projected values are monitored more closely to determine the cause of the variance. If the cause cannot be related to operational considerations, such as mining activity, then additional field investigation is undertaken to characterize the conditions. Should the field data indicate that ground conditions are deteriorating, corrective actions are taken as required.

Geologic investigations provide ongoing data collection on the geotechnical performance of the underground facility, and include geologic and fracture mapping, seismic monitoring, and special activities performed as-needed. Further assessments of the geotechnical performance of the excavations are made using borehole inspections to detect displacements, fractures, and separations occurring within the strata immediately surrounding the excavations. The results of geologic investigations provide continued confidence in the performance and geology of the site with respect to site characterization.

All data obtained are maintained for data reduction, tabulation, analysis, and archiving. The annual Geotechnical Analysis Report provides the principal documentation of data, describes the techniques used for data acquisition, and summarizes the performance history of the instruments. The Geotechnical Analysis Report also details the geotechnical performance of the various underground facilities including shafts, and provides an evaluation of the geotechnical aspects of performance in the context of the relevant design criteria developed during the SPDV phase. The Geotechnical Analysis Report is reviewed by the DOE and its contractors for technical accuracy. These reports have been regularly prepared, audited for quality assurance, and made publicly available since 1983.

The assessment and evaluation of the condition of WIPP excavations is an interactive, continuous process using the data from the monitoring programs. Criteria for corrective actions are continually reevaluated and reassessed based on total performance to date. Actions taken are based on these analyses and planned utilization of the excavation. Because WIPP excavations are in a natural geologic medium, there is inherent variability from point to point. The principle adopted is to anticipate potential ground control requirements and implement them in a timely manner rather than to wait until a need arises.

References for Section 4.3

1. WP 05-WH, WIPP Waste Handling Operations Procedures.

2. WP 12-HP, WIPP Operational Health Physics series Procedures.

3. DOE/WIPP, 91-005, RCRA, Part B Permit Application, Rev. 6.

4. WIPP-DOE-069, Westinghouse Electric Corporation, TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Rev 5., April 1996.

5. WP 05-WA.06, WIPP Waste Information System Software Requirements Specification, Rev. 0

6. WIPP/WID 96-2180, Long-Term Ground Control Plan for the Waste Isolation Pilot Plant.

7. NQA-1, Quality Assurance Program, 1989.

8. WP -AU1007, Underground Openings Inspections.

9. Title 30, Code of Federal Regulations Part 57, Safety and Health Standards - Underground Metal and Nonmetal Mines, 8th edition, 1994.

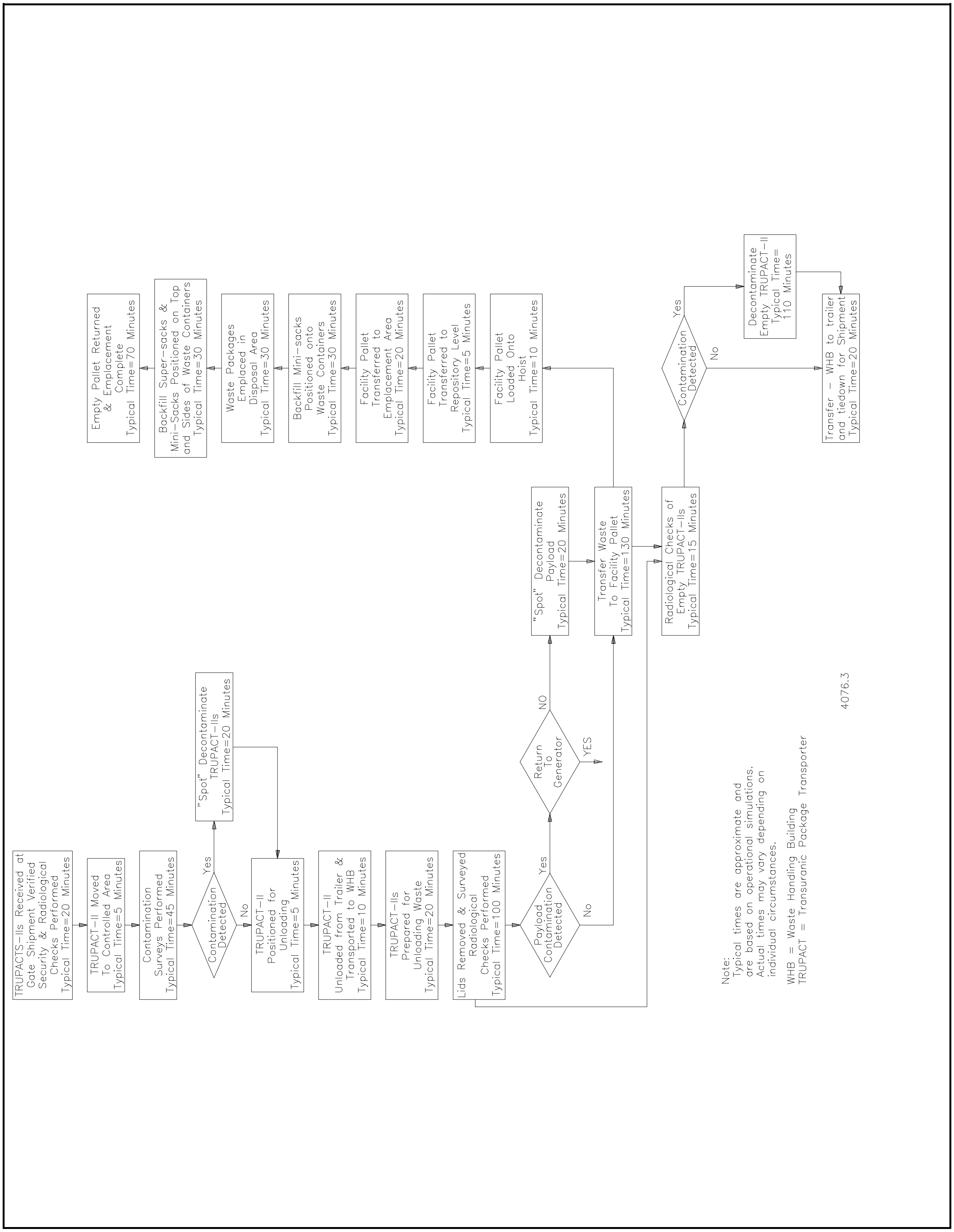


Figure 4.3-1, Surface and Underground CH Flow Diagram

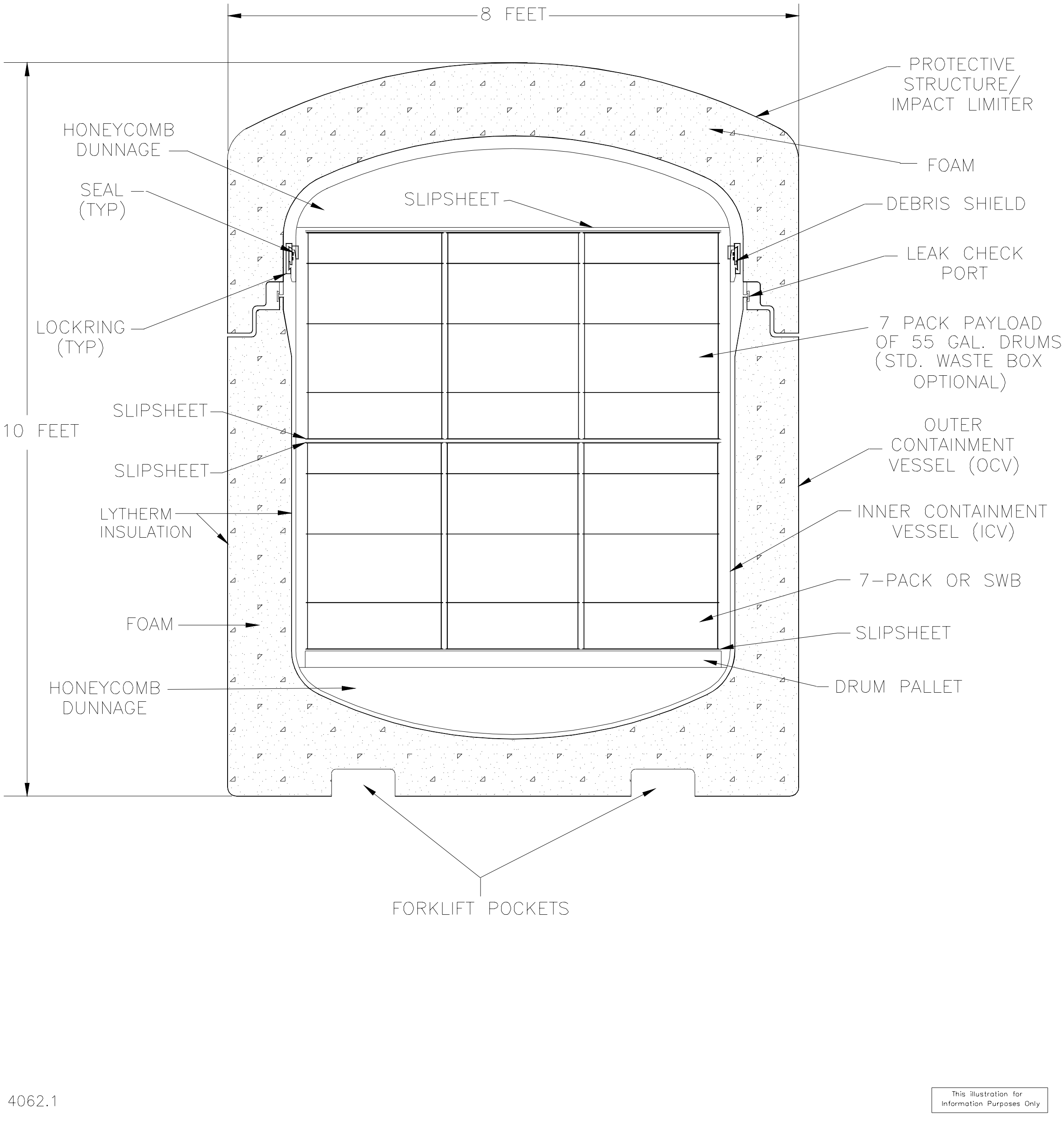


Figure 4.3-2, TRUPACT-II

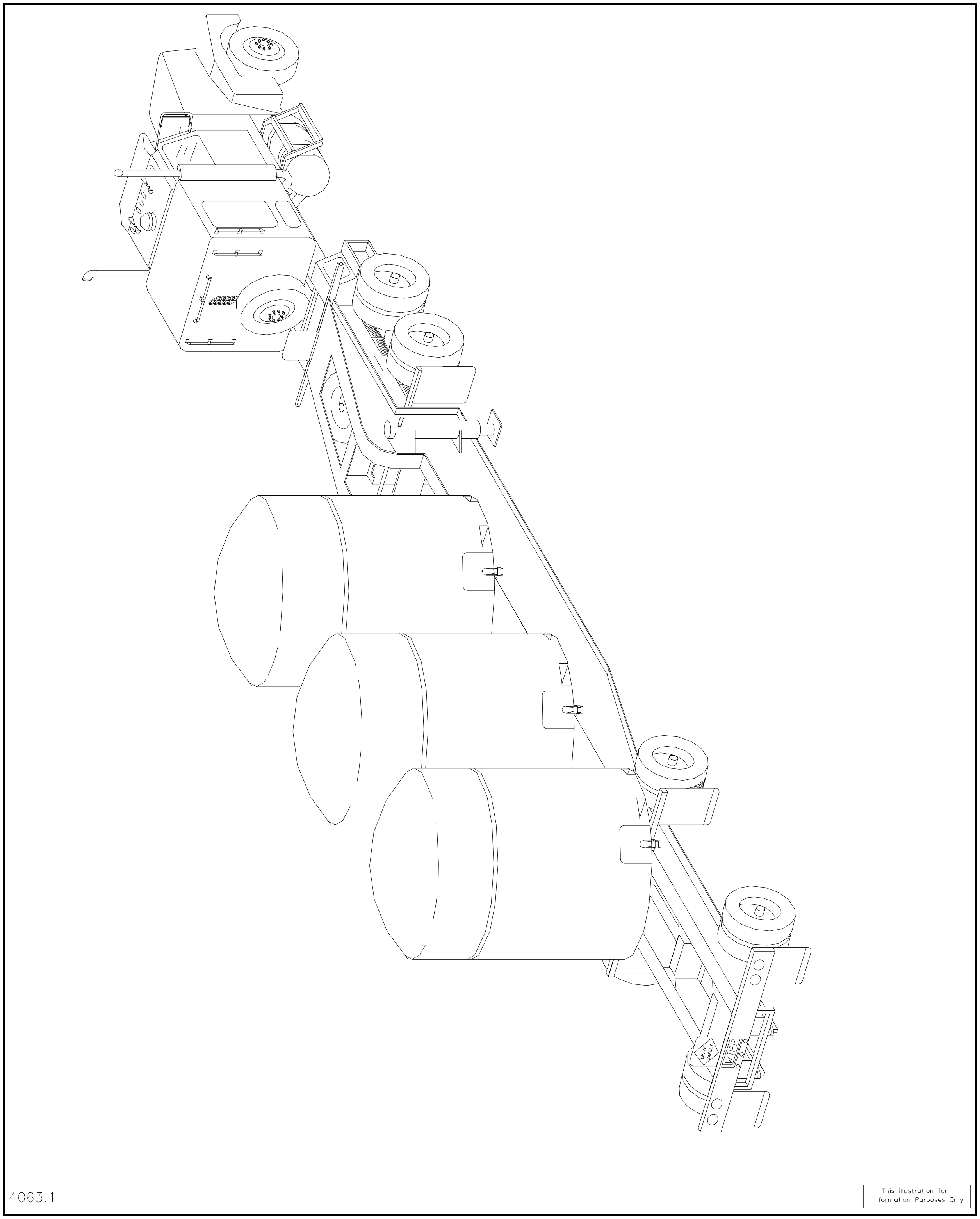


Figure 4.3-3, Truck, Trailer, and TRUPACT-IIs

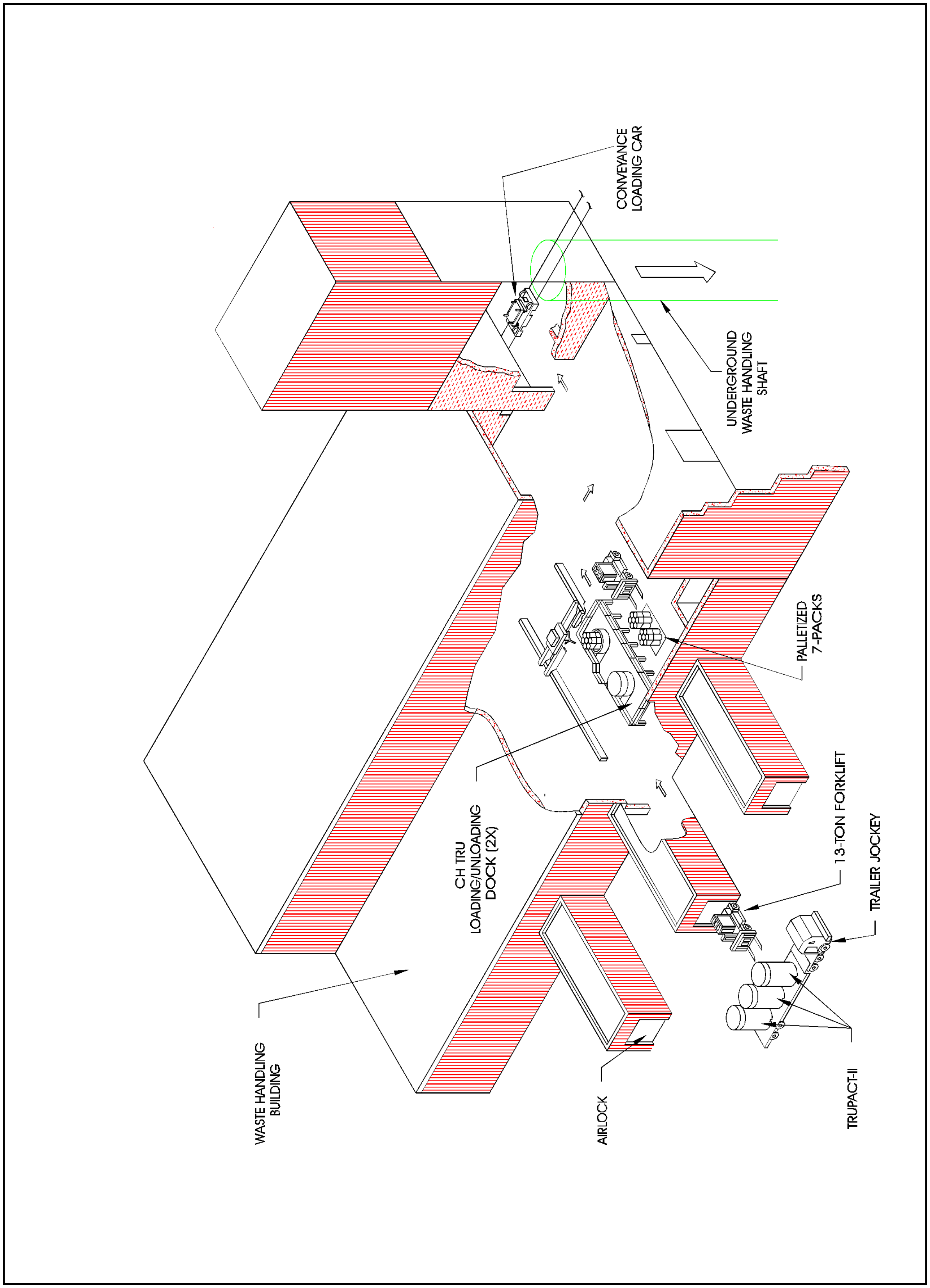


Figure 4.3-4, CH TRU Waste Handling (Surface)

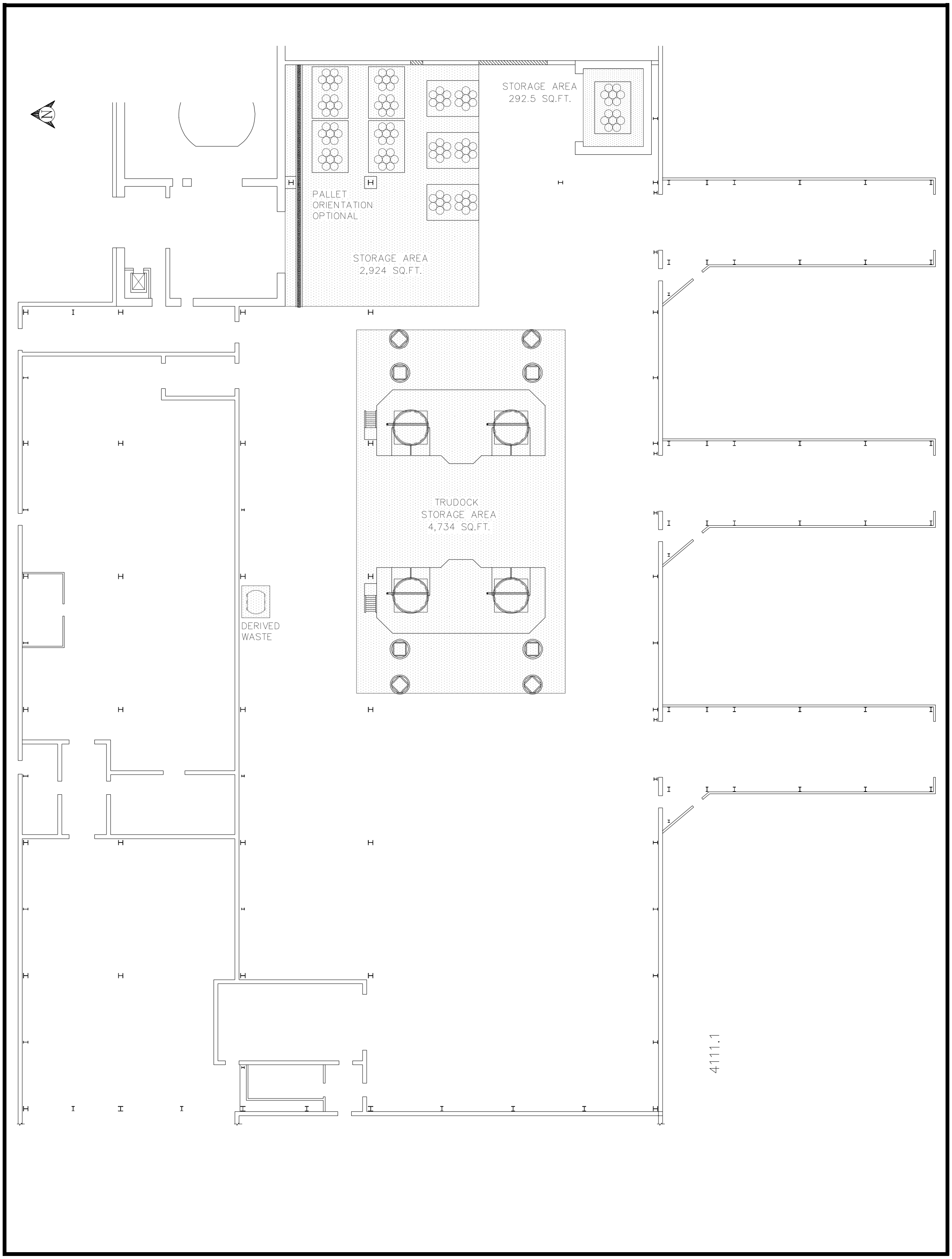


Figure 4.3-5, Waste Handling Building Temporary Storage Areas for CH Waste Containers

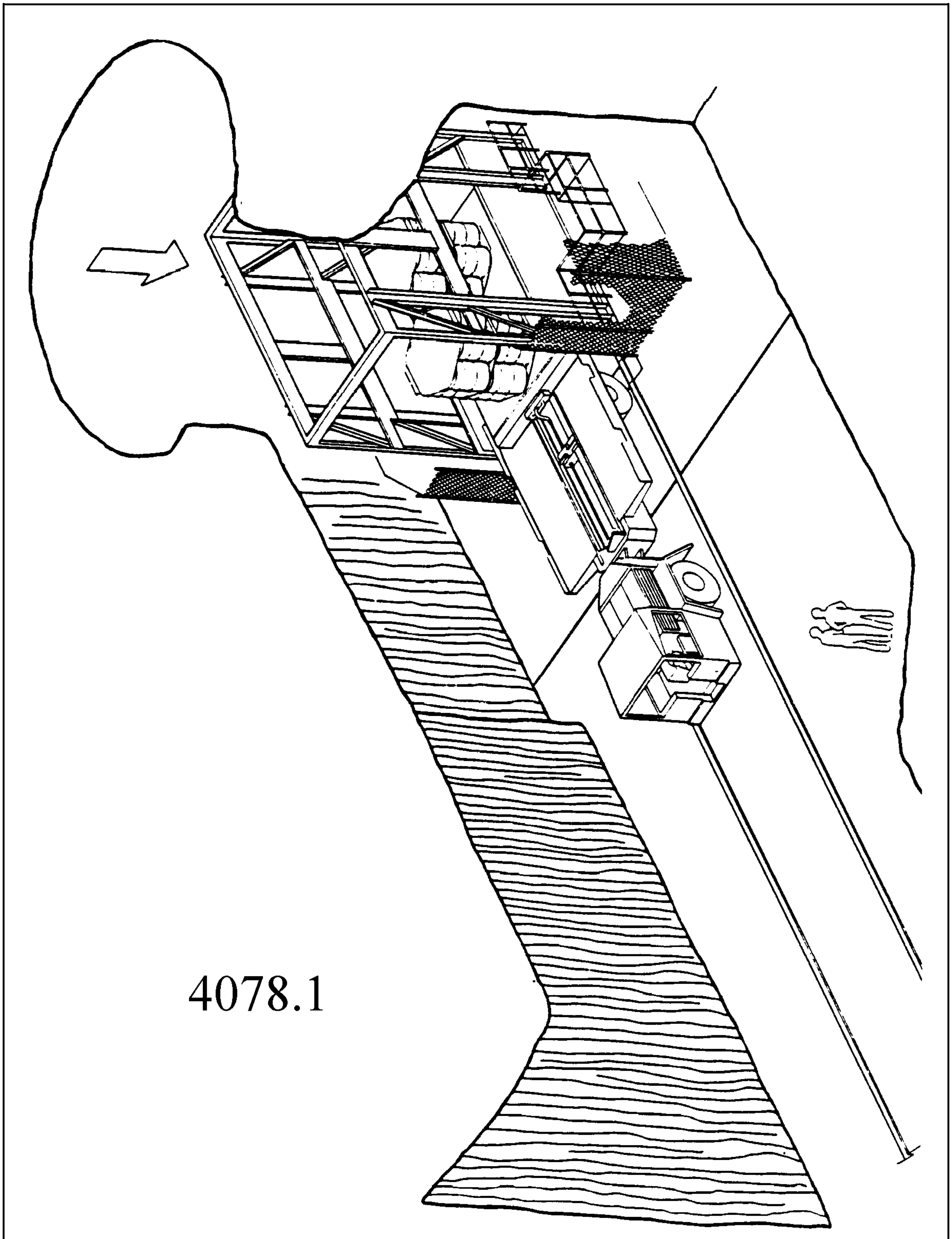


Figure 4.3-6, CH TRU Waste Handling (Underground)

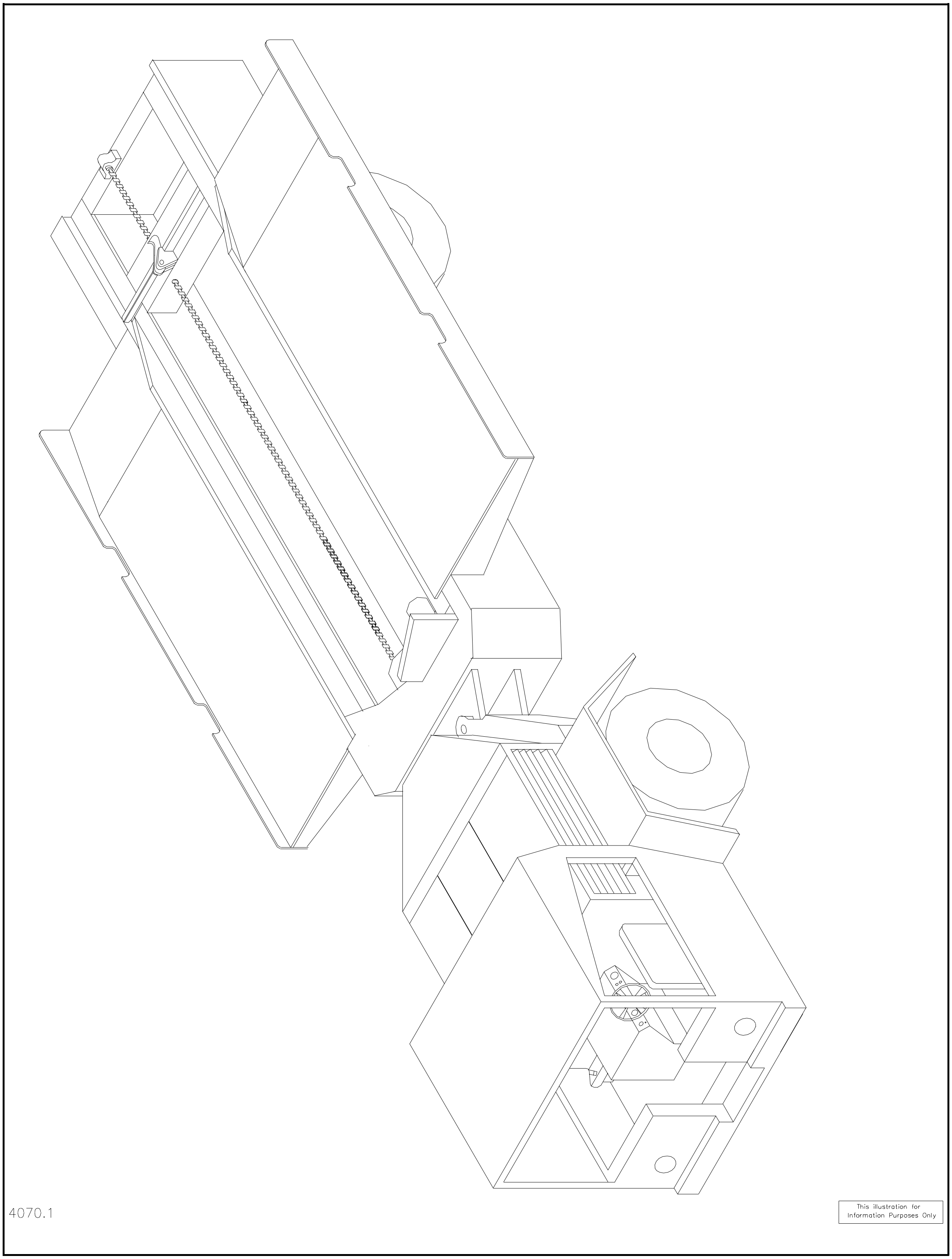


Figure 4.3-7, CH TRU Underground Transporter

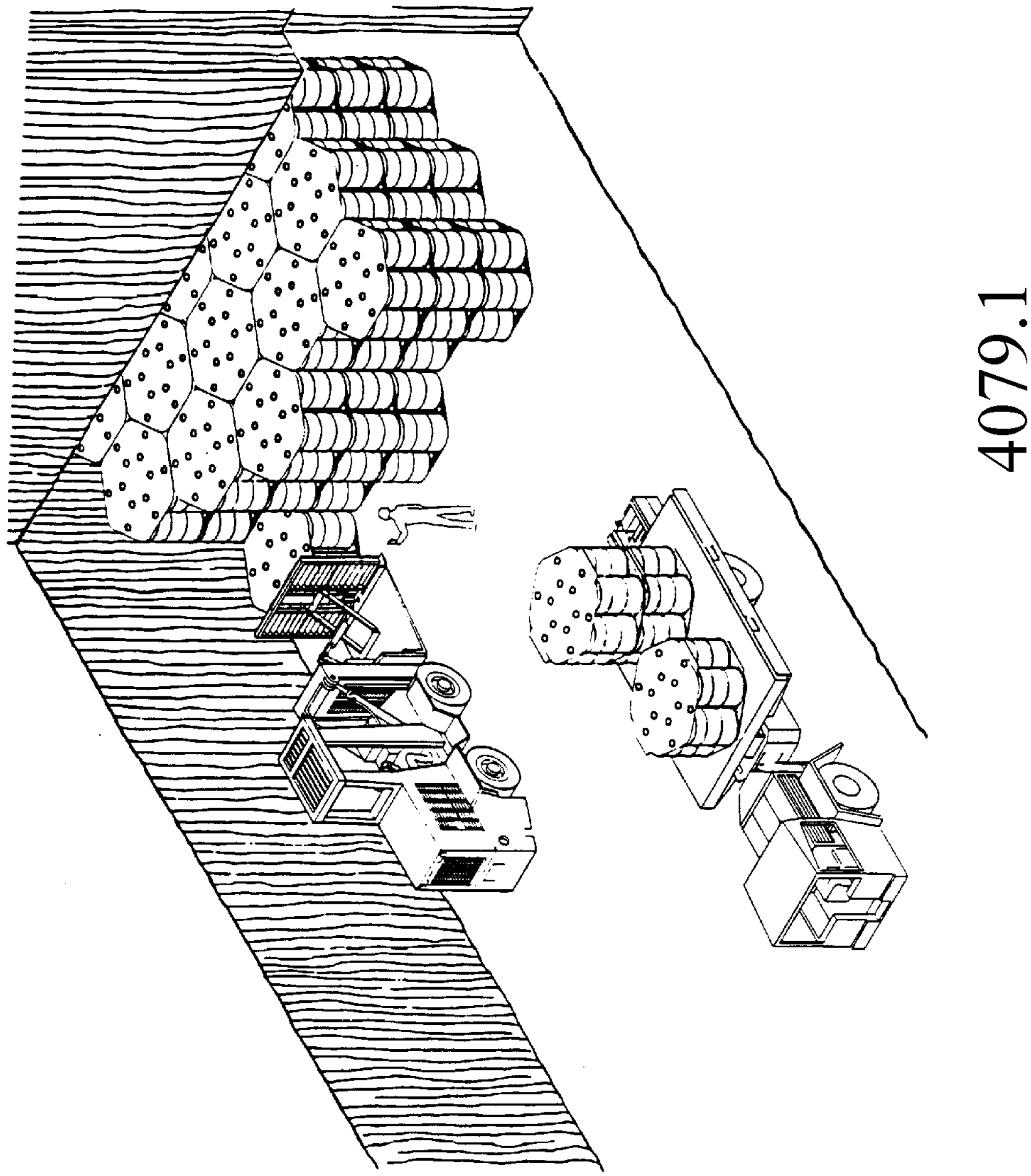


Figure 4.3-8a, CH TRU Emplacement

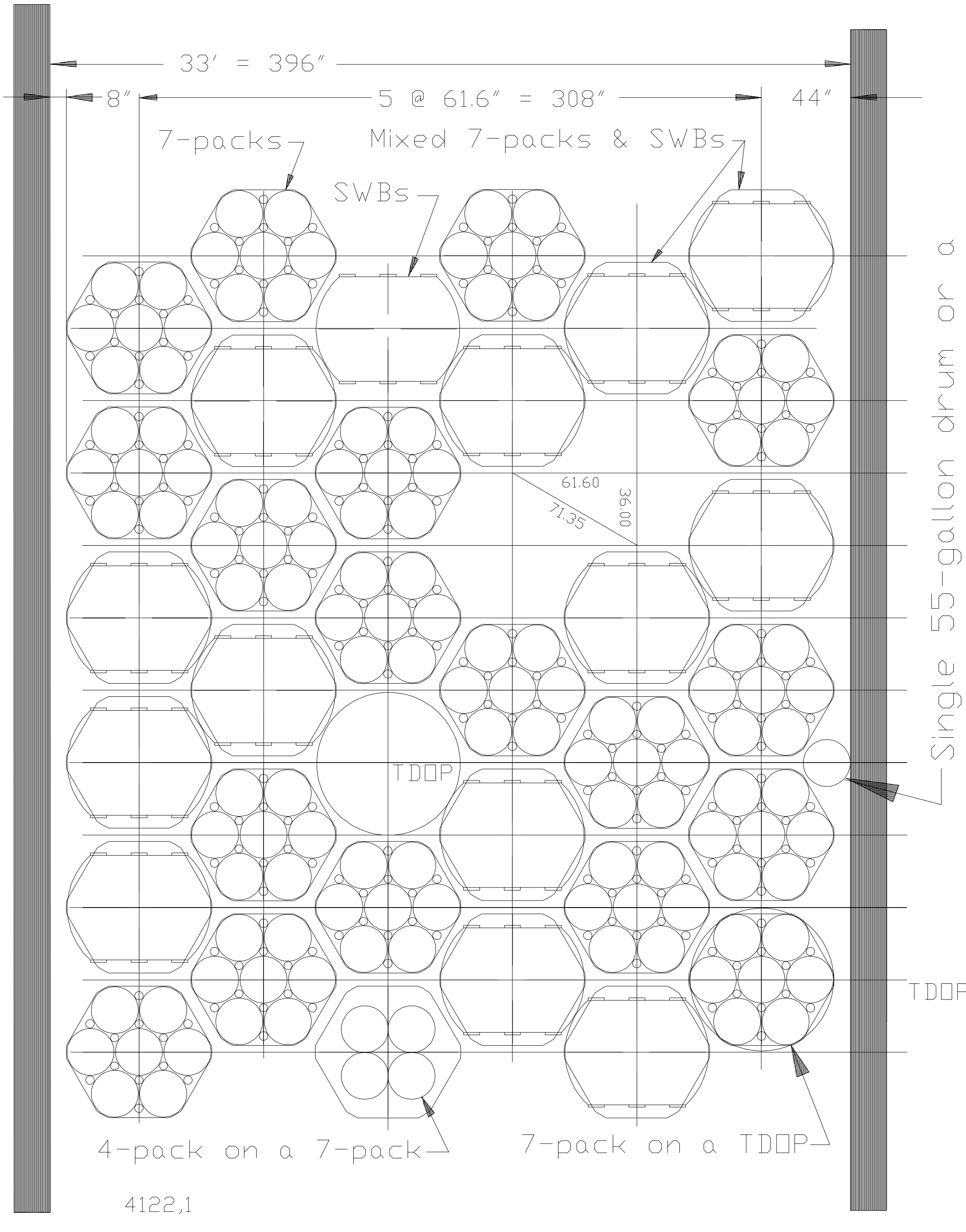


Figure 4.3-8b, Arrangement of Typical Waste Stacks

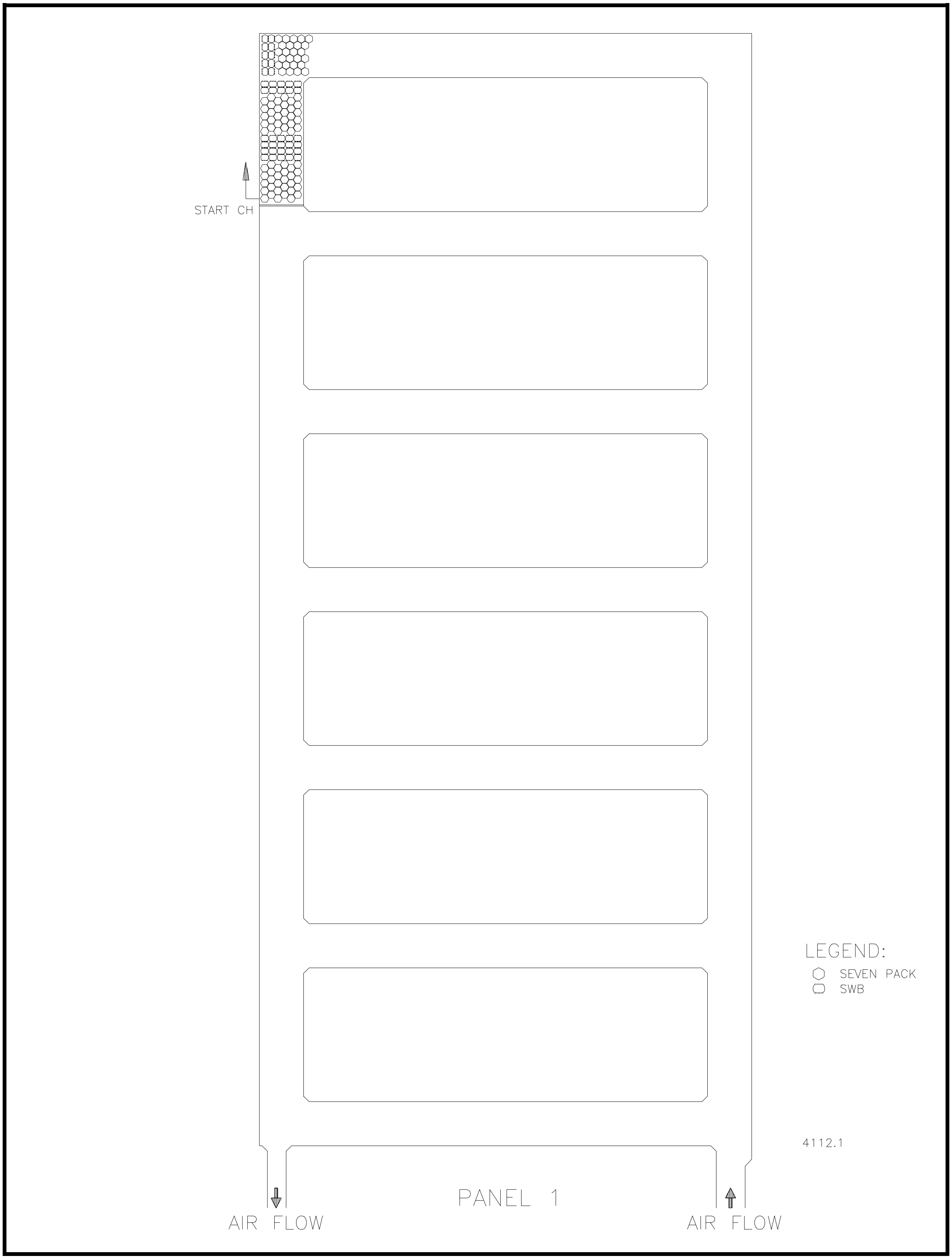


Figure 4.3-9a, Underground Waste Emplacement Process

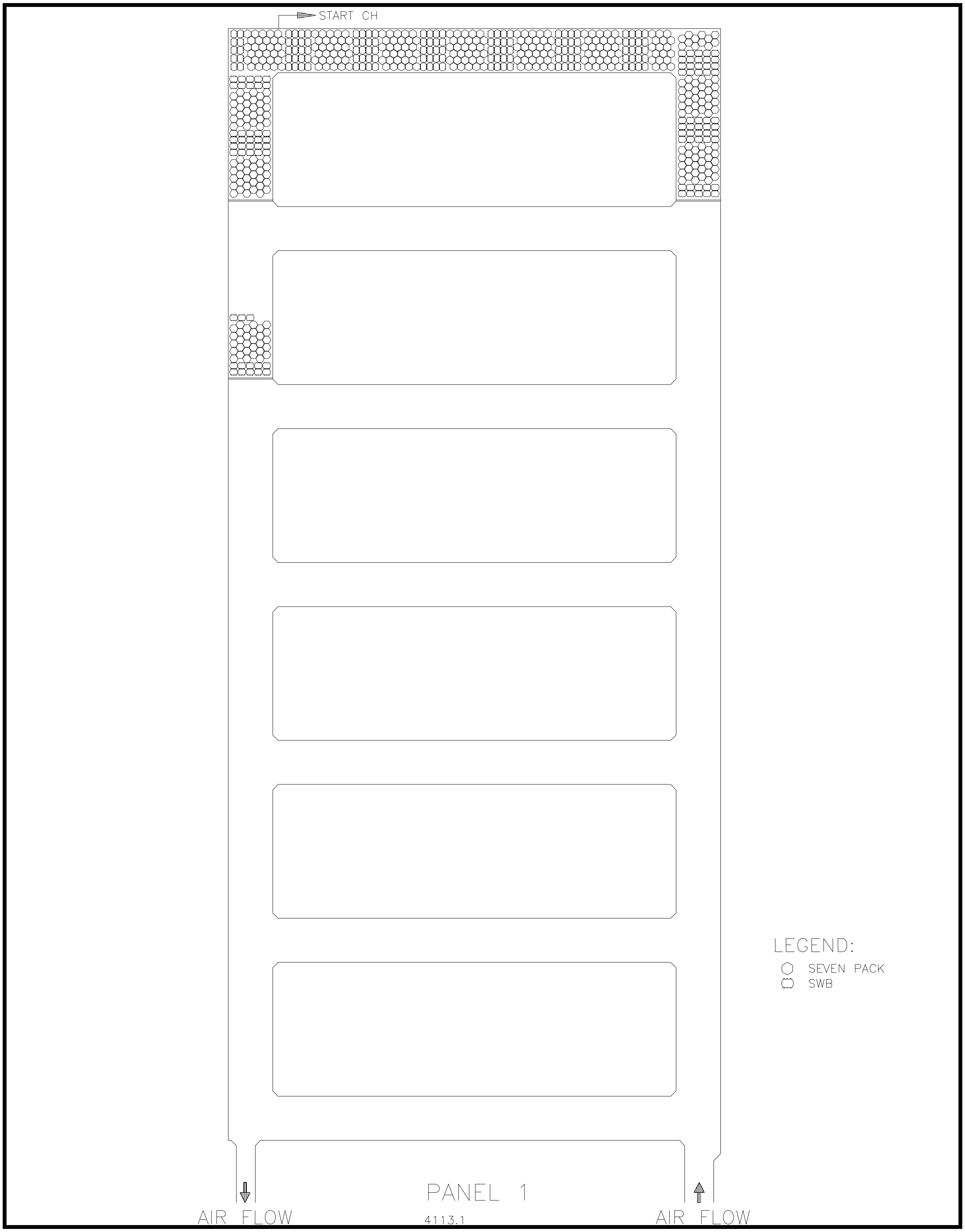


Figure 4.3-9b, Waste Emplacement Process

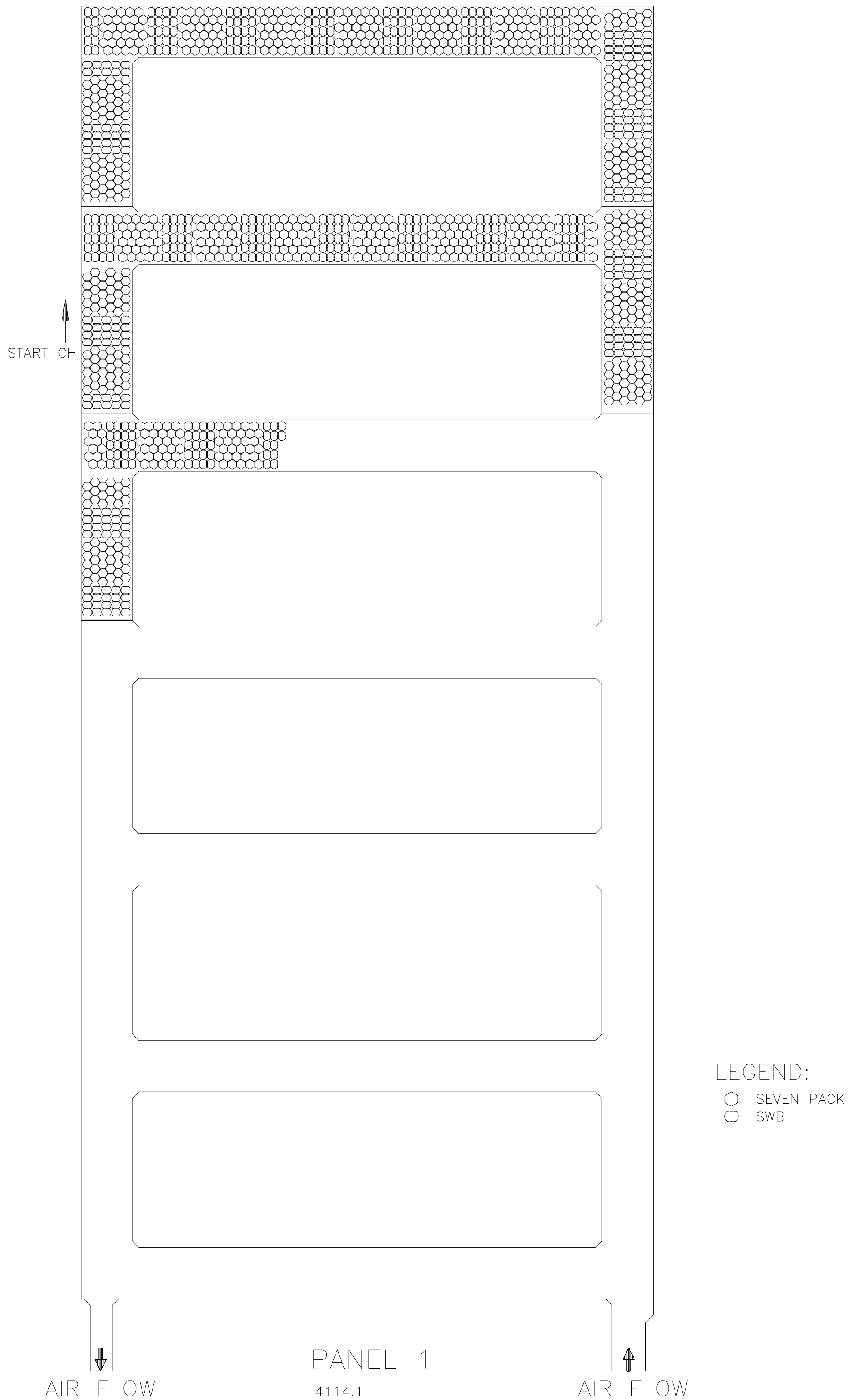


Figure 4.3-9c, Waste Emplacement Process

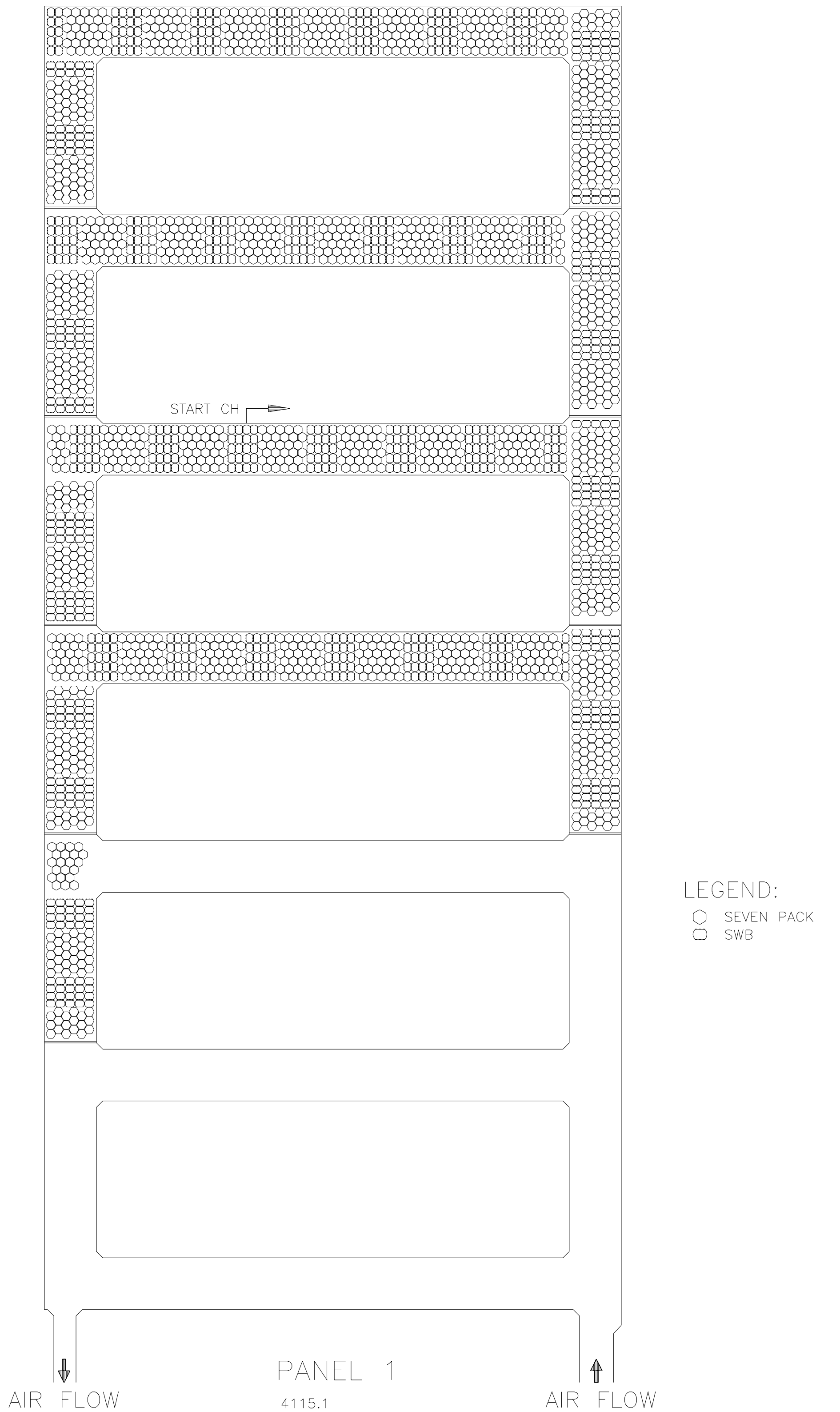


Figure 4.3-9d, Waste Emplacement Process

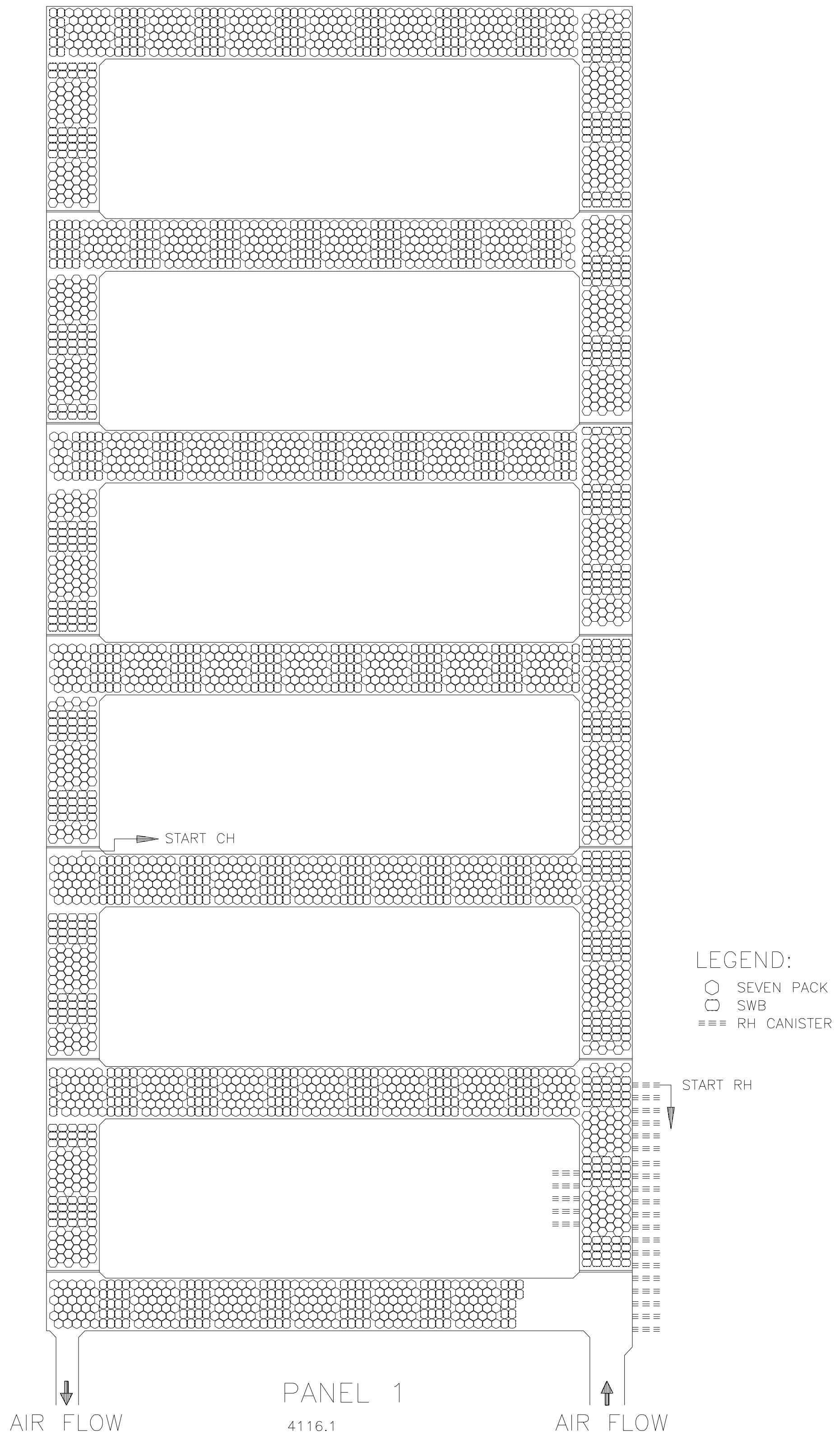


Figure 4.3-9e, Waste Emplacement Process

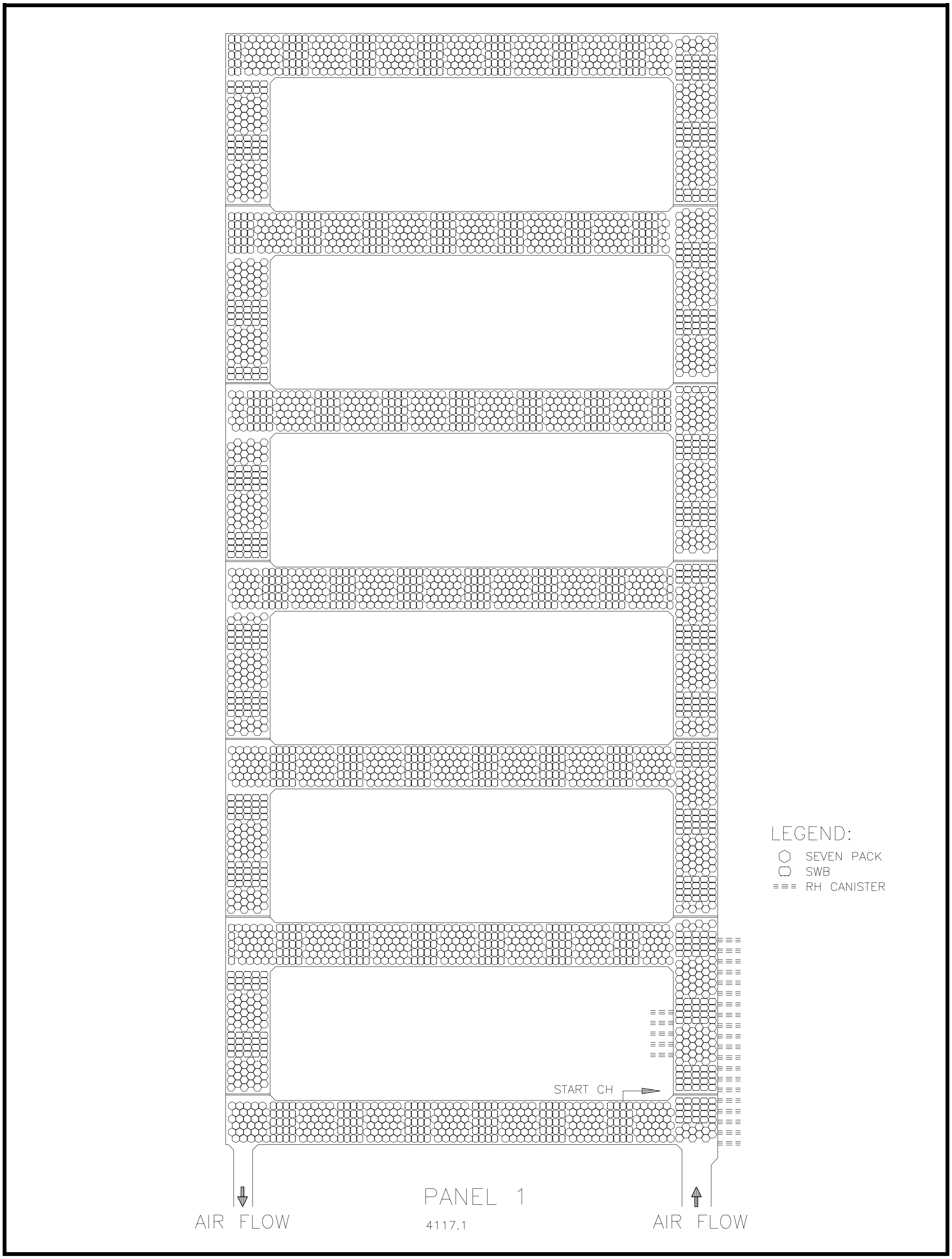


Figure 4.3-10, Panel 1 Filled with Waste

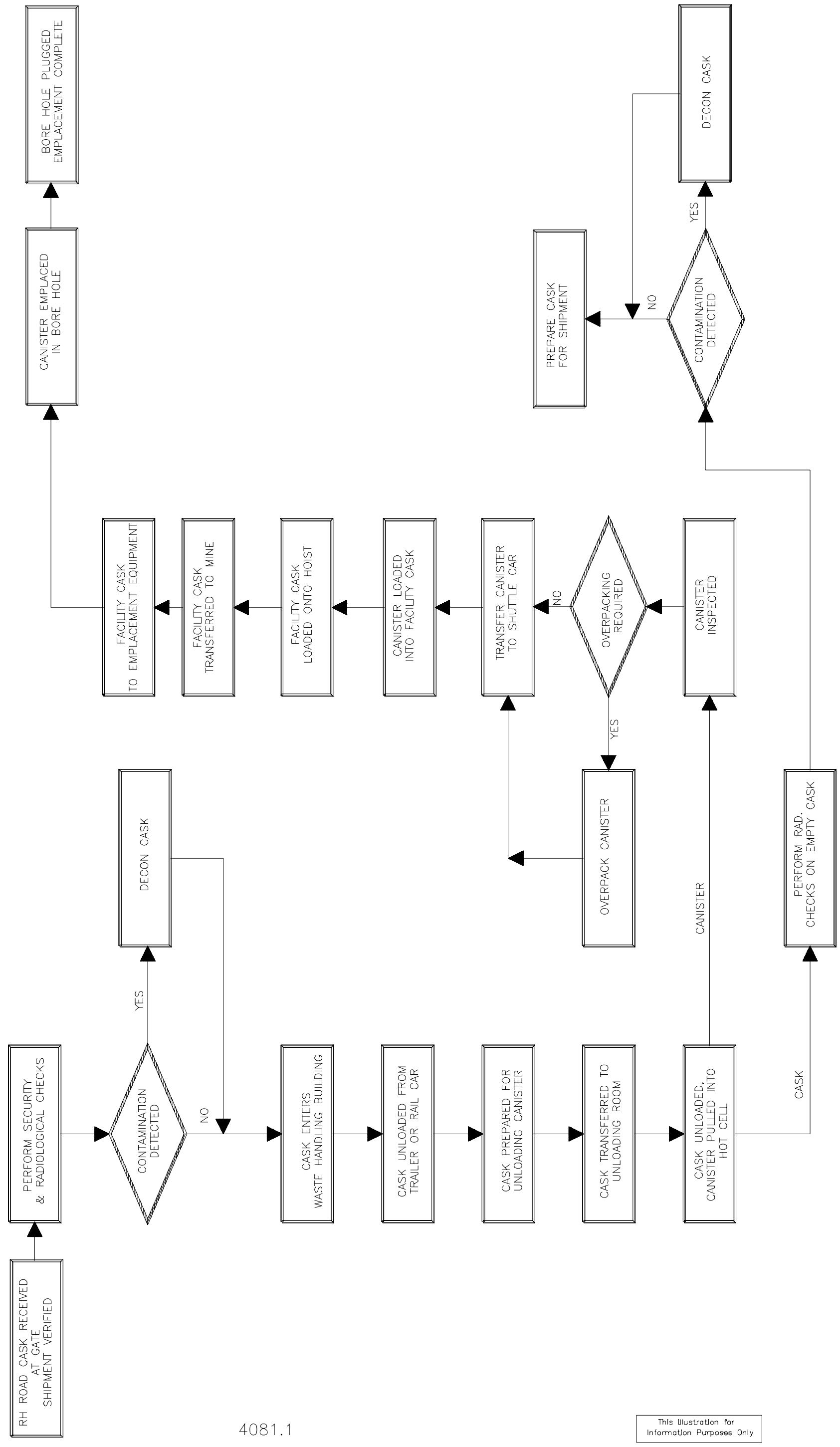


Figure 4.3-11, Surface and Underground RH TRU Waste Process Flow Diagram

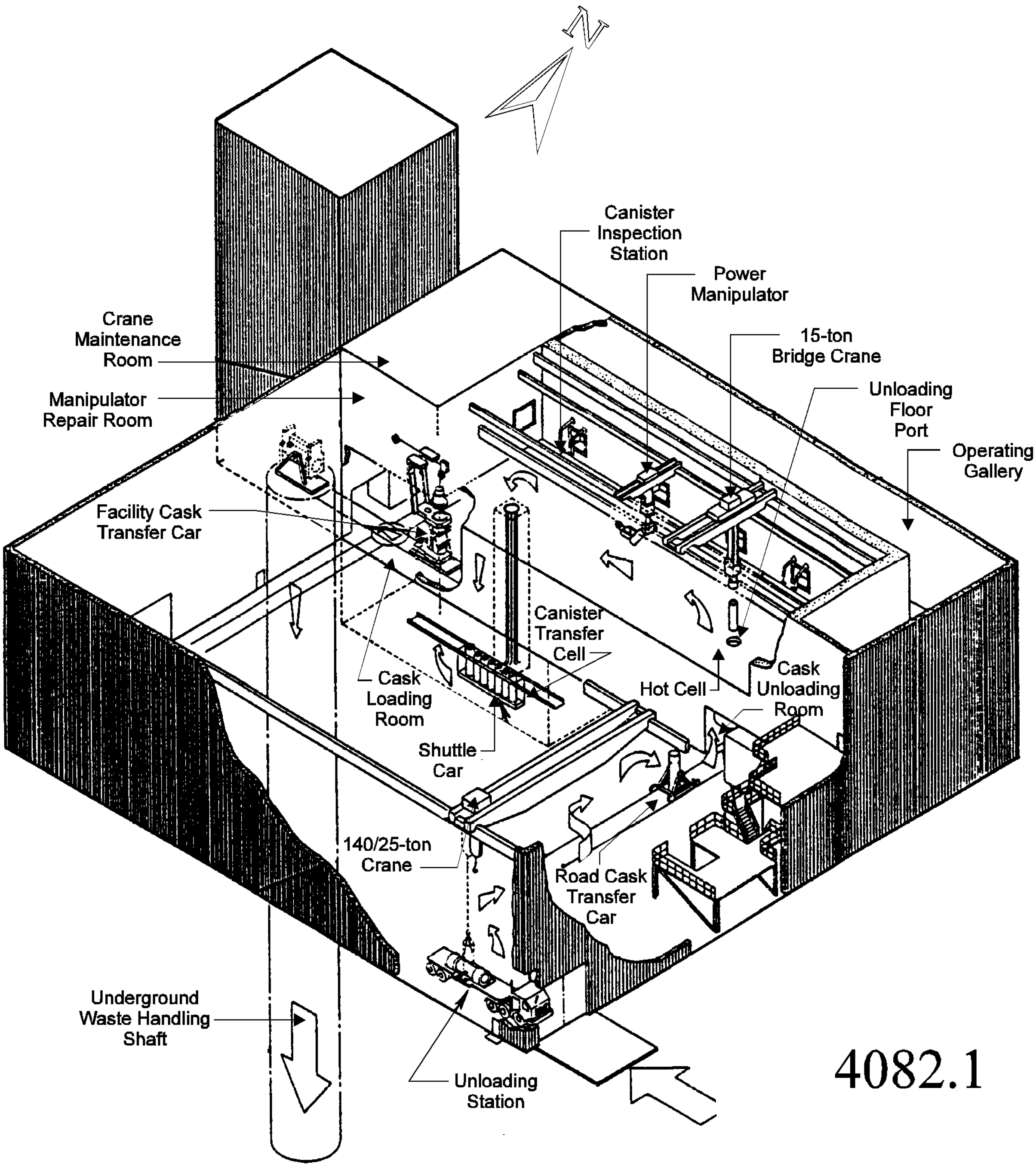


Figure 4.3-12, Pictorial View of the RH TRU Surface Operation

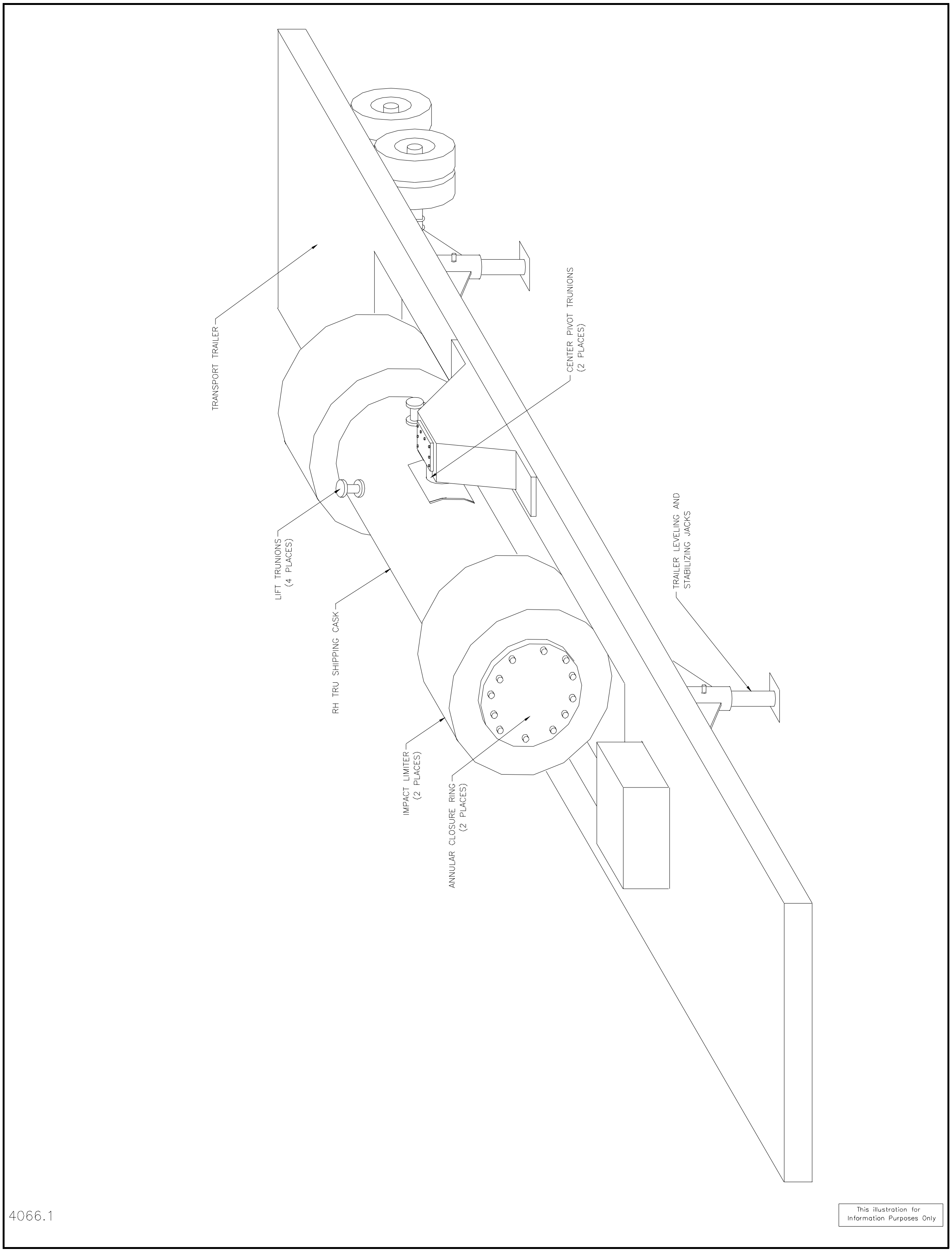


Figure 4.3-13, RH TRU Road Cask on Trailer

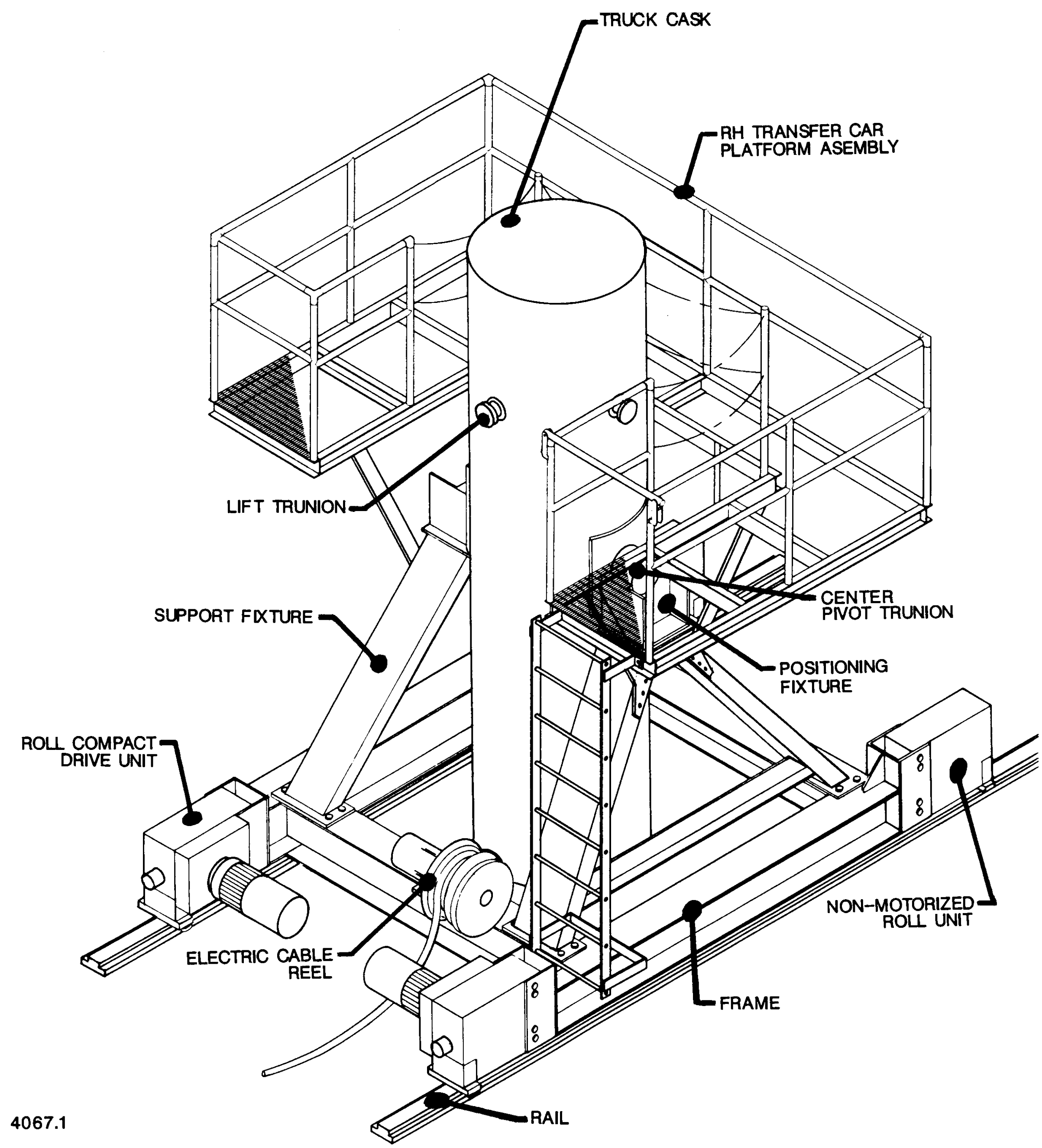


Figure 4.3-14, RH TRU Waste Shielded Road Cask on Transfer Car

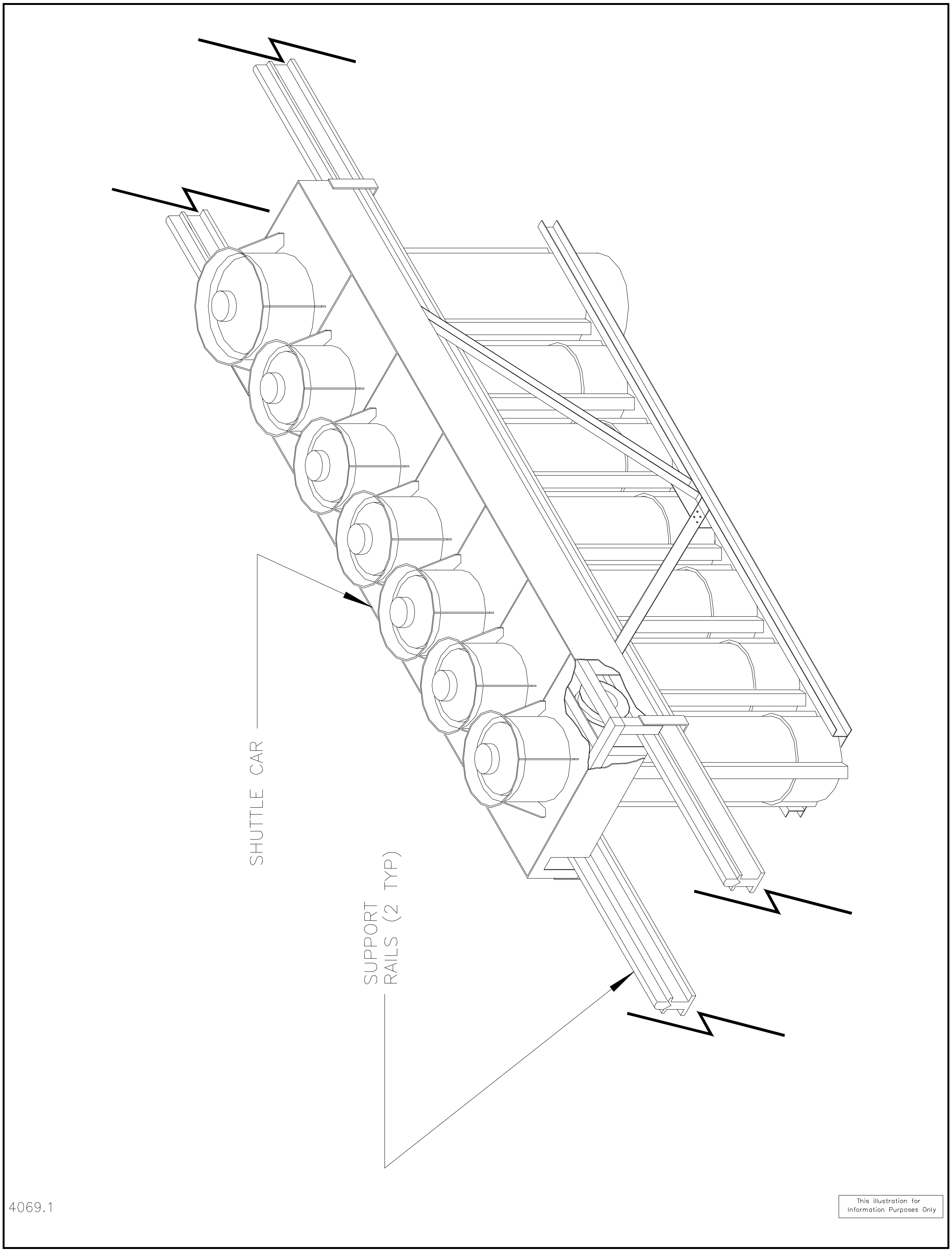


Figure 4.3-15, RH TRU Canister Shuttle Car

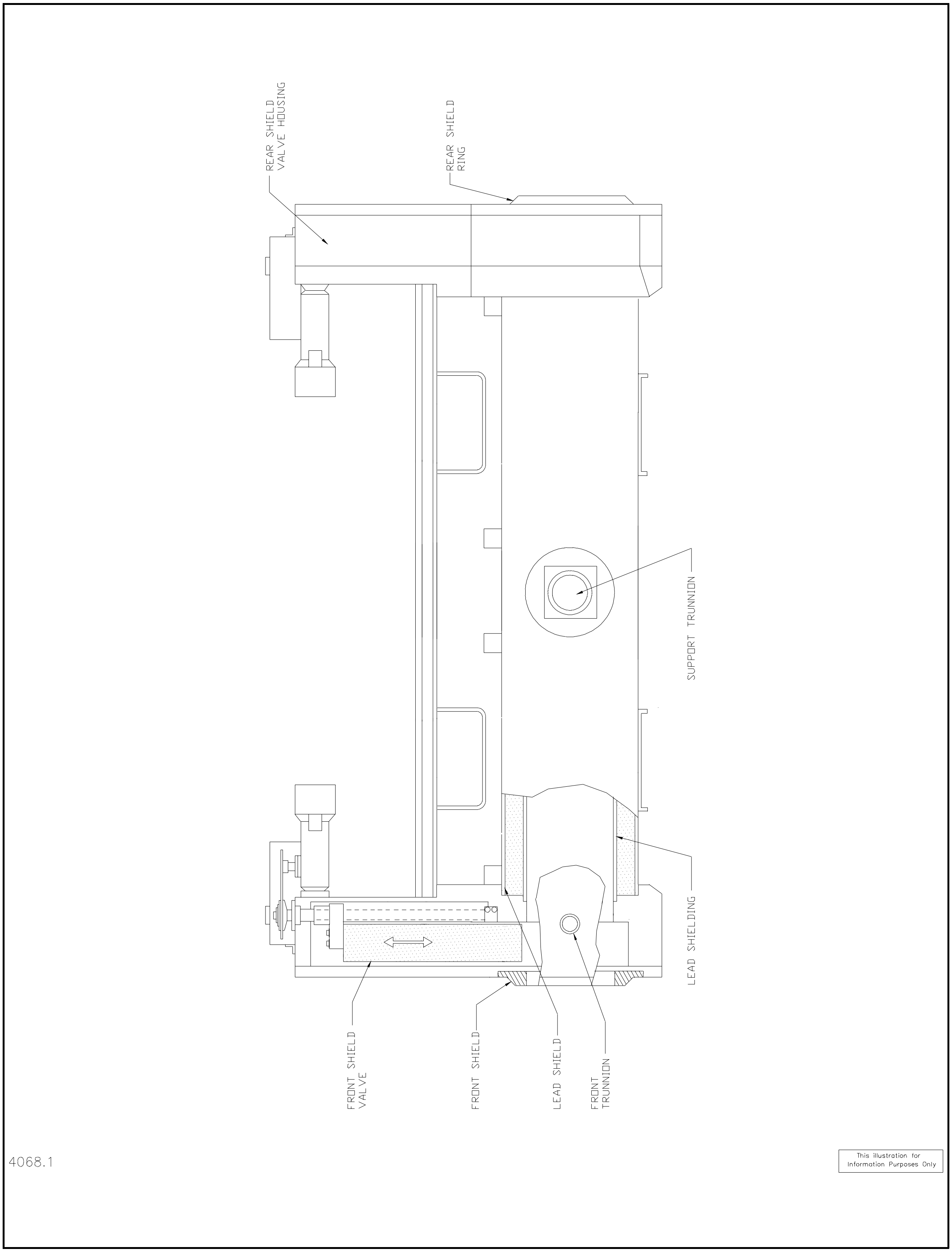


Figure 4.3-16, RH TRU Facility Cask

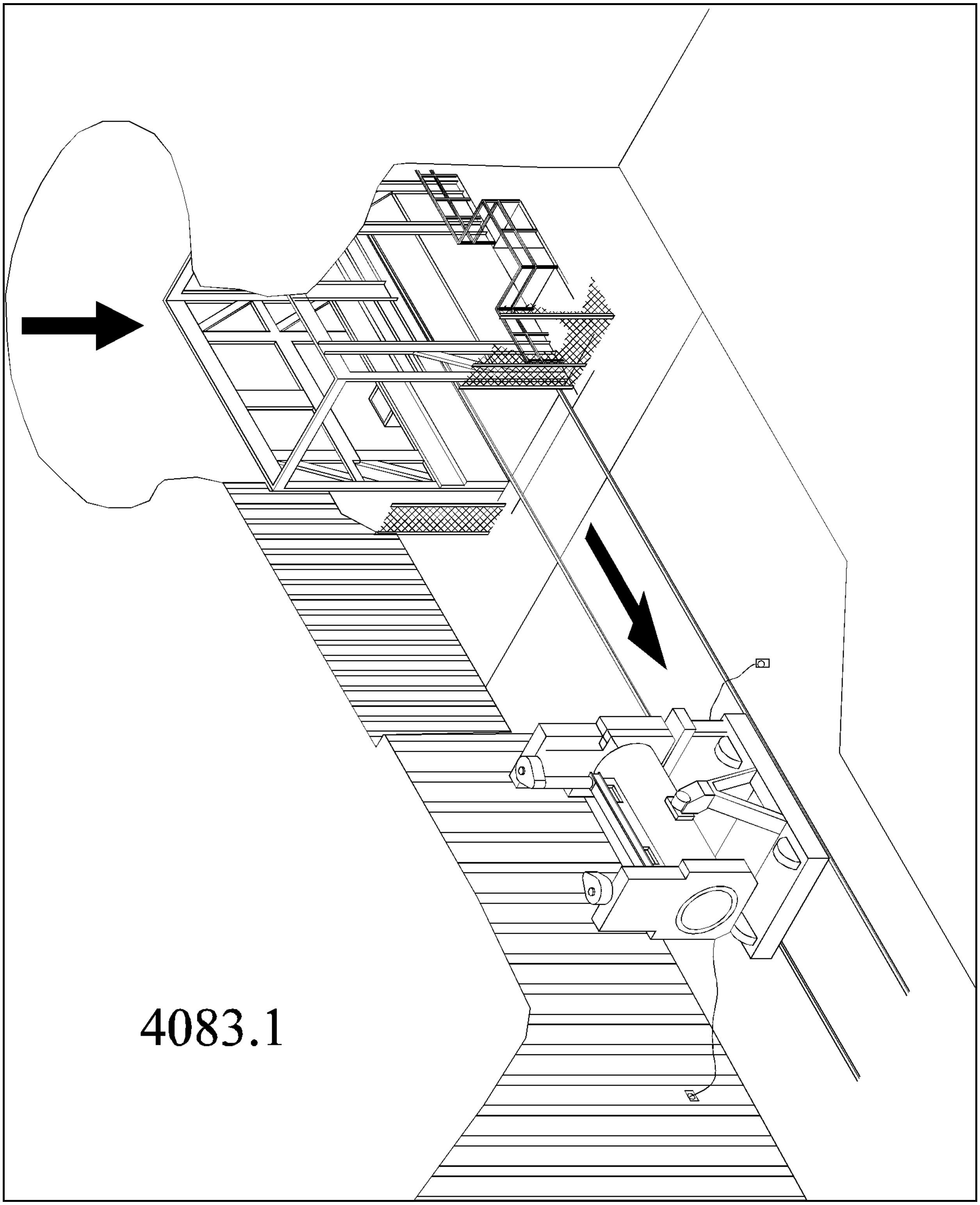


Figure 4.3-17, RH TRU Waste Handling Facility Cask Unloading from Cage

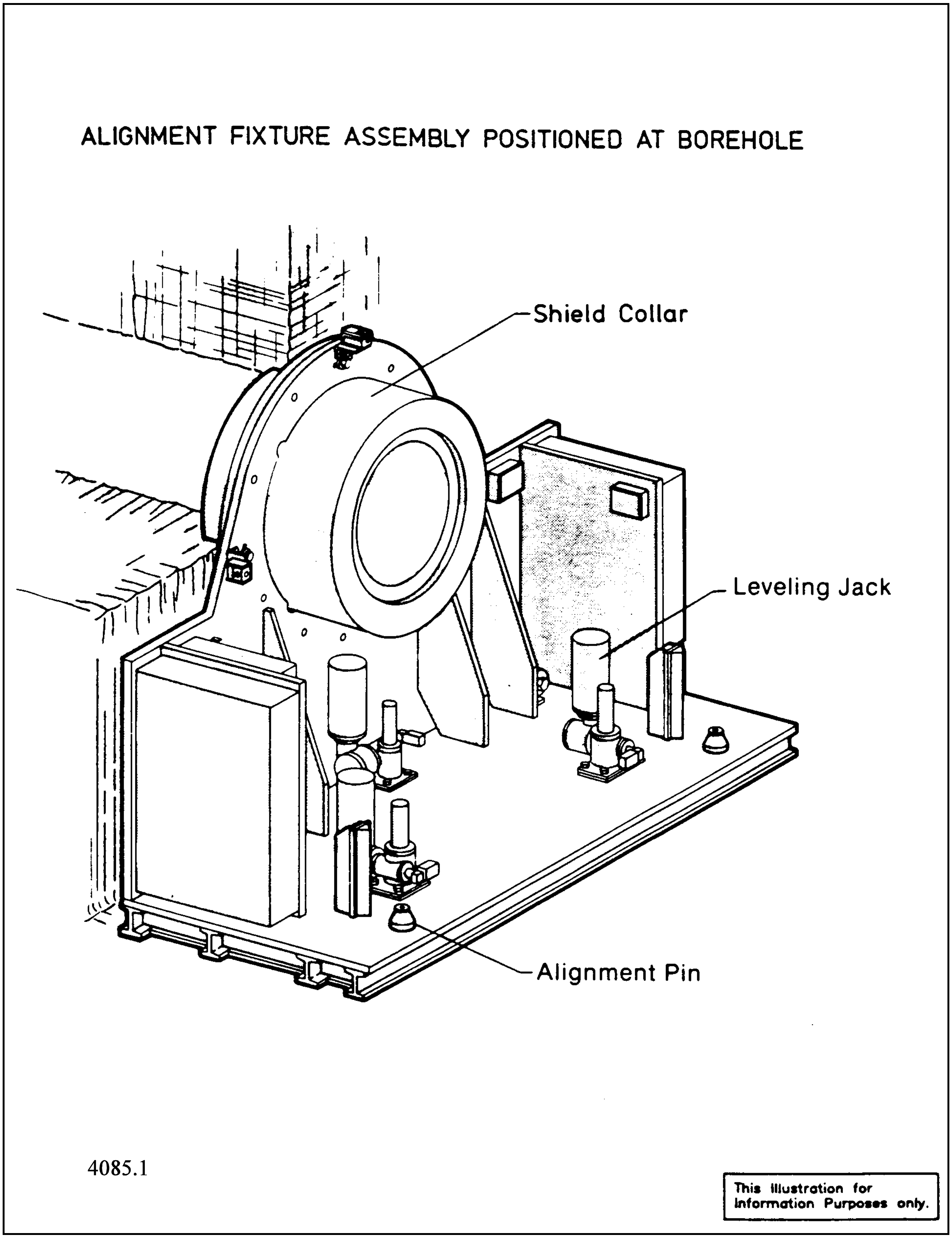


Figure 4.3-18, RH TRU Emplacement Alignment Fixture

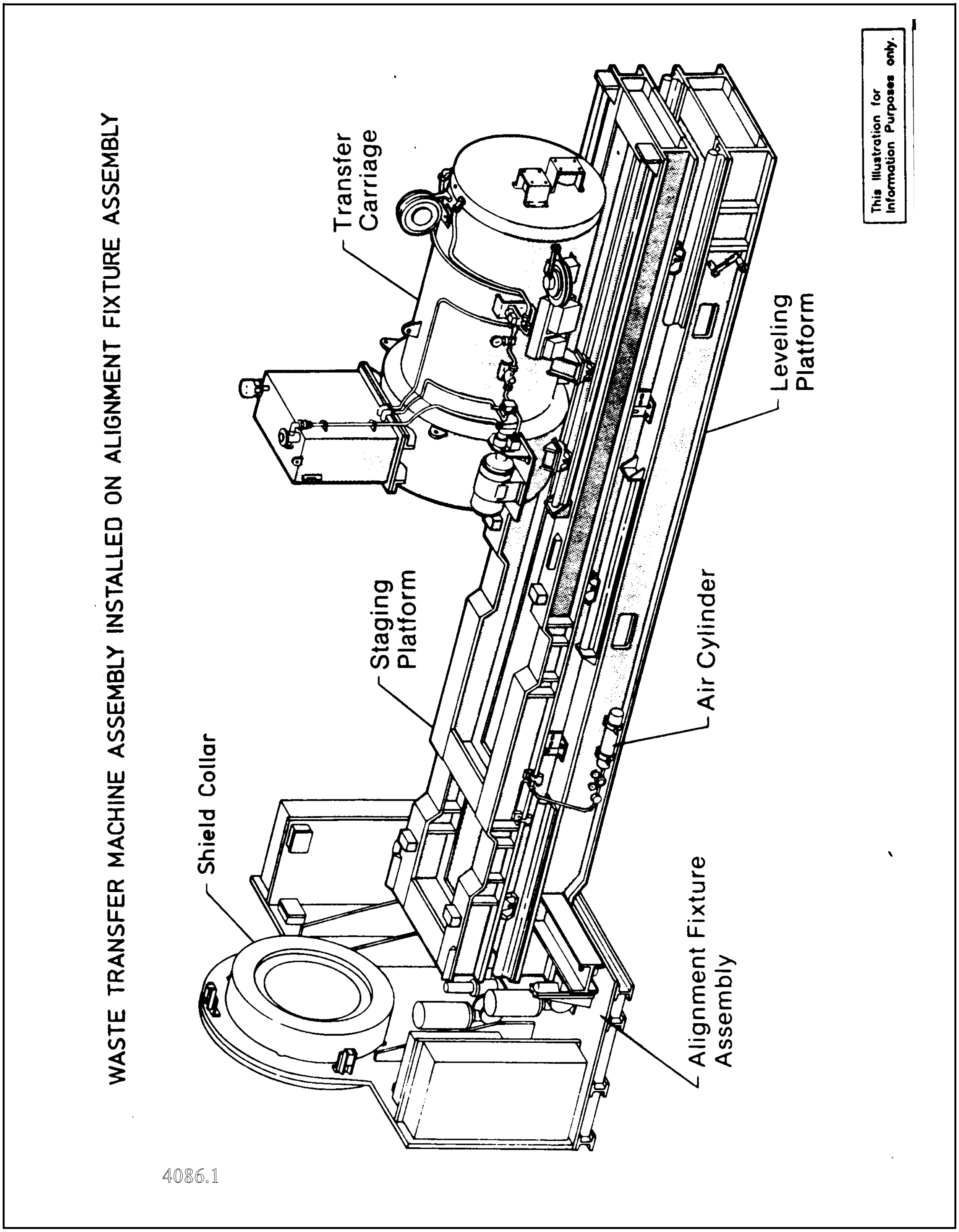
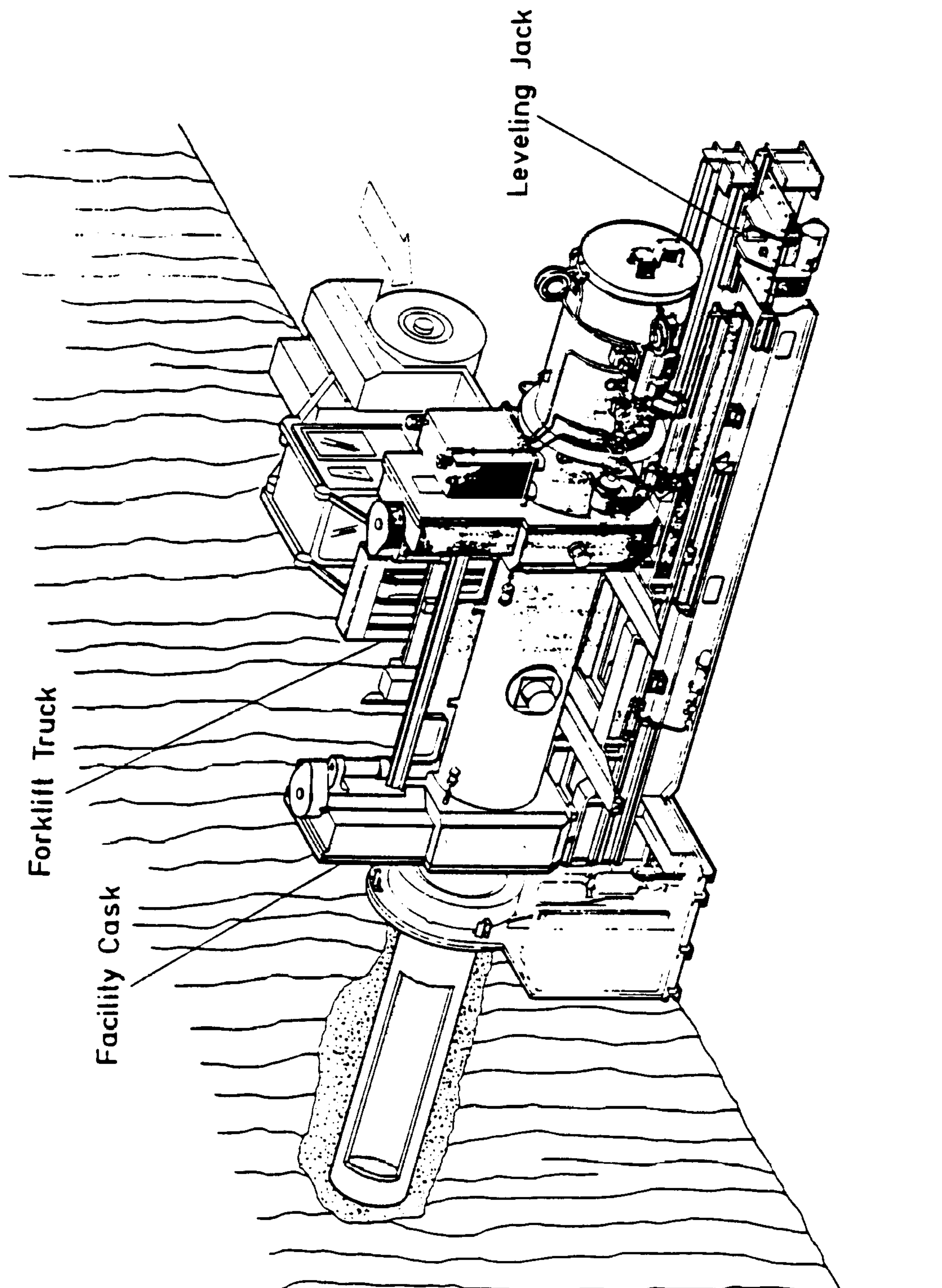


Figure 4.3-19, Waste Transfer Machine Assembly Installed on the Alignment Fixture



Source: DOE, 1990, 5.2-34.

Figure 4.3-20, Facility Cask Installed on the Waste Transfer Machine Assembly

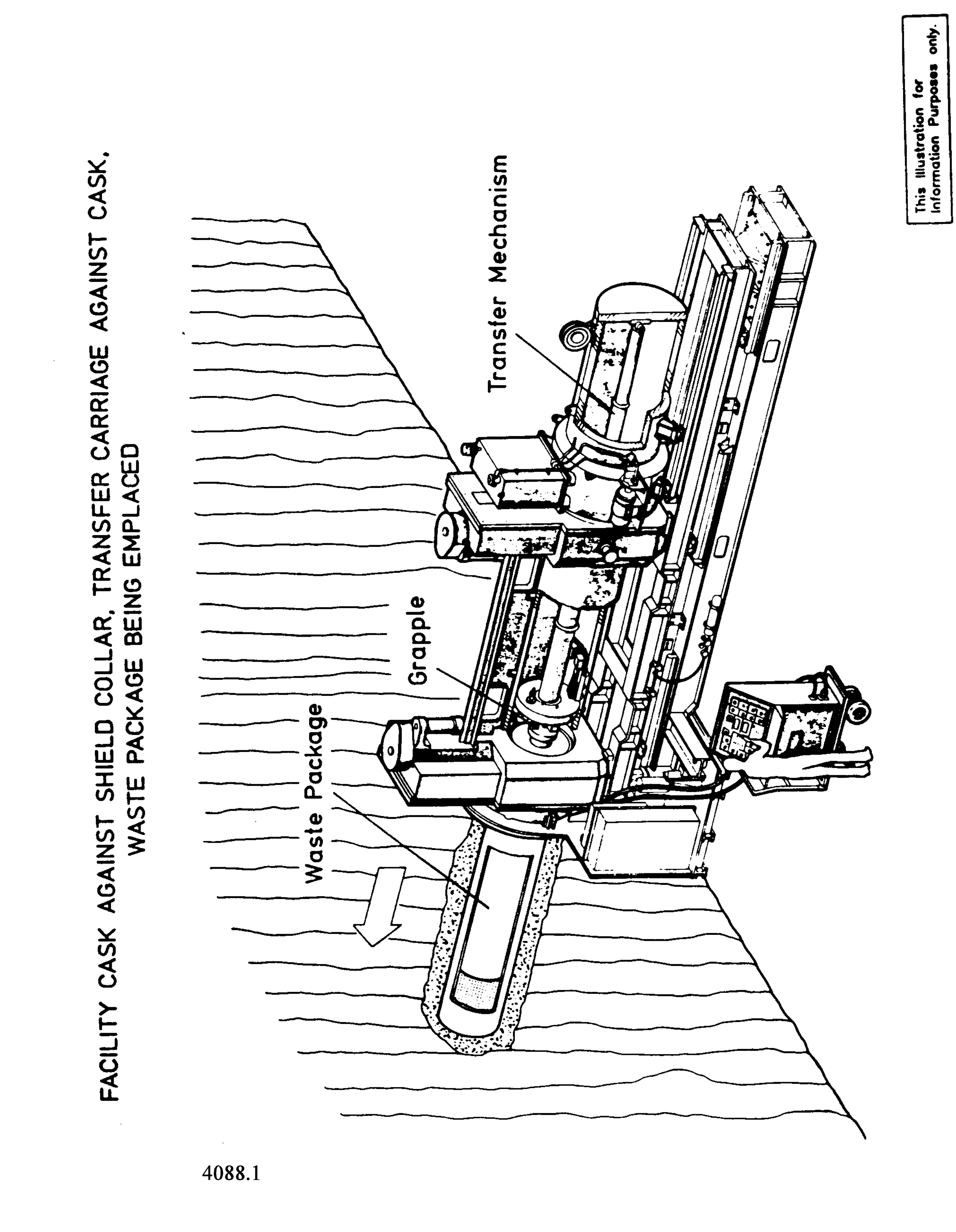


Figure 4.3-21, Waste Emplacement Equipment

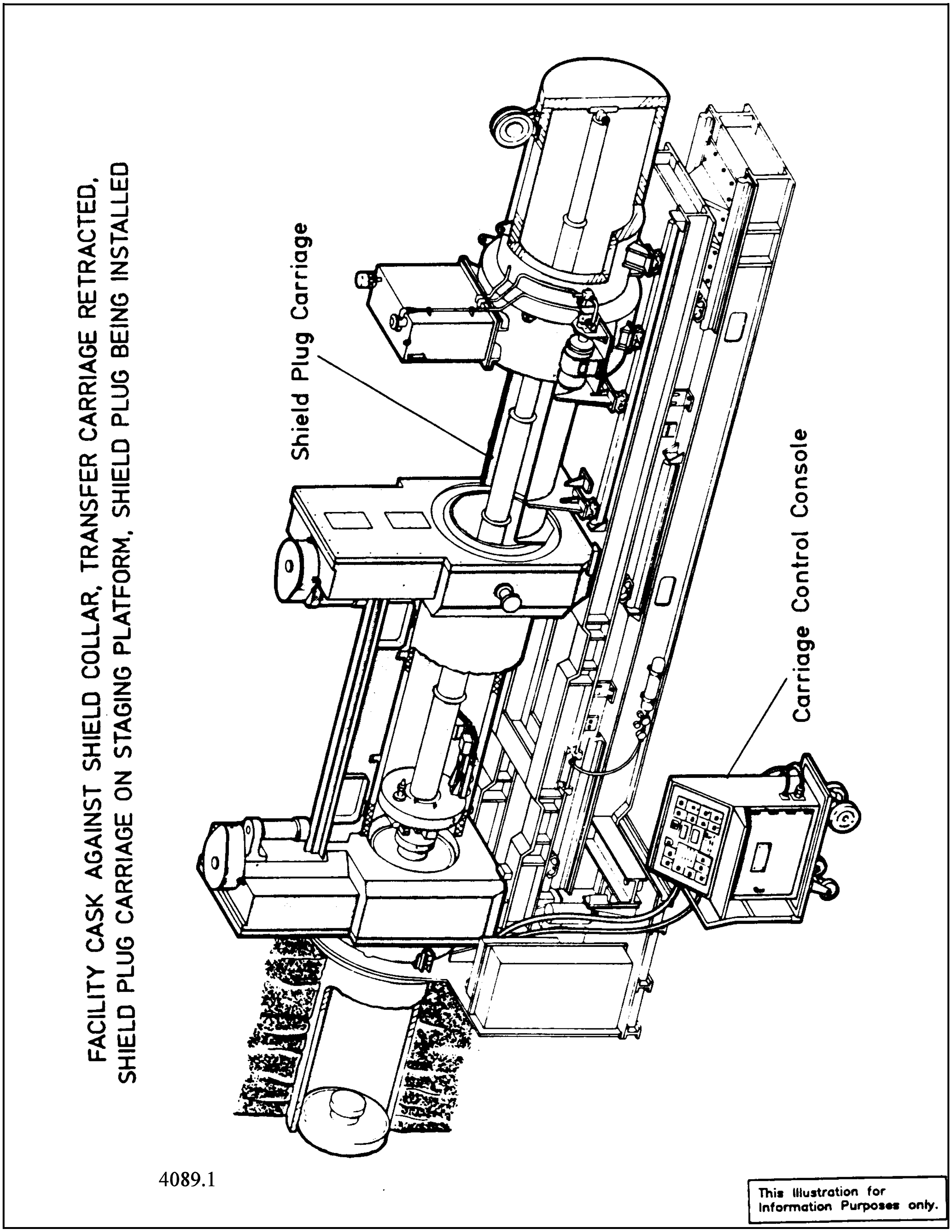


Figure 4.3-22, Installing Shield Plug

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4.4 Confinement Systems

4.4.1 Confinement

The WIPP facility confinement system consists of static and dynamic barriers designed to meet the following requirements of DOE Order 6430.1A,[1] Section 1300-7:

- Minimize the spread of radioactive and other hazardous materials within the unoccupied process areas.
- Prevent, if possible, or minimize the spread of radioactive and other hazardous materials to occupied areas.
- Minimize the release of radioactive and other hazardous materials in facility effluents during normal operation and anticipated operational occurrences.
- Limit the release of radioactive and other hazardous materials resulting from Design Basis Accidents (DBAs) including severe natural phenomena and man-made events in compliance with the guidelines contained in DOE Order 6430.1A,[1] Section 1300-1.4.2, Accidental Releases.

Static barriers are structures that confine contamination by their physical presence, and dynamic barriers control the flow of contamination in the air. For the WIPP, static barriers consist of waste containers, building structures, geological strata, and HEPA filtration systems; Dynamic barriers consist of the surface and subsurface ventilation systems that maintain pressure differentials ensuring airflow is from areas of lower to higher contamination potential.

In addition to the above general requirements, the WIPP is designed to meet the specific confinement requirements of DOE Order 6430.1A,[1] Section 1324-6 and Section 1300-1.4.

For the WIPP, the primary confinement is the static barrier consisting of the waste containers, and the secondary confinement consists of those SSCs designed to remain functional (following DBAs) to the extent that the guidelines in DOE Order 6430.1A,[1] Section 1300-1.4.2, Accidental Releases, are met.

Consistent with DOE Order 6430.1A,[1] Section 1324-6, tertiary confinement is not required for the WIPP during disposal operations. Tertiary confinement will only be applicable during post-closure.

4.4.1.1 Waste Handling Building

Static and dynamic barriers are incorporated into the design of the WHB confinement system, and the primary confinement is the drum or container holding the waste.

The secondary confinement consists of the SSCs that house the primary confinement, including the shielded road cask, the TRUPACT shipping container, the rooms, the building walls, and the ventilation system, which maintains a static pressure differential between the primary confinement barriers and the environment. To assist the ventilation system, "air locks" are provided between separate areas where pressure differentials are necessary. The WHB HEPA filtration system connects with the ventilation systems and provides the final barrier for airborne particulates.

4.4.1.2 Underground

The primary confinement system for the underground is the drum or container being disposed in the underground. The secondary confinement consists of the natural barrier formed by the salt in the underground disposal areas and the underground bulkheads, which separate the disposal and mining areas. The underground ventilation system has provisions for exhausting to the exhaust filtration system, when in use, to mitigate any accidental releases of contaminated airborne particulates.

4.4.2 Ventilation Systems

The WIPP facility air handling systems are designed to provide a suitable environment for personnel and equipment during plant operations, and to provide contamination control for operational occurrences and postulated waste handling accidents. Certain components of the air handling systems are also used for functions related to space cooling and removal of heat.

The WIPP facility air handling systems serve three major plant areas: the surface facilities, the surface support facilities, and the subsurface facilities.

The air handling systems are designed to meet the emissions limitations in DOE Order 5400.5[2] using the following general guidelines:

- Transfer and leakage air flow is from areas of lower to areas of higher potential for contamination.

- In building areas that have a potential for contamination, a negative pressure is maintained to minimize the spread of contaminants.

- Consideration is given to the temporary disruption of normal air flow patterns due to scheduled and unscheduled maintenance operations by providing dual trains of supply and exhaust equipment. Air handling systems are provided with features to reestablish designed airflow patterns in the event of a temporary disruption. Generally, ducts that carry potentially contaminated air are routed away from occupied areas. In addition, potentially contaminated ducts are welded to the maximum extent practical to reduce system leakage.

The filtration system consists of prefilters and HEPA filters sized in accordance with design air flows utilizing the manufacturer's rating standards for maximum efficiency.

HVAC components are sized so that some components can be taken out of service for maintenance, allowing the system to continue operation. The schematic flow diagrams of the ventilation systems are shown in Figures 4.4-1 through 4.4-5.

4.4.2.1 Surface Ventilation Systems in Controlled Areas

There are independent ventilation systems for each of the following areas:

- Waste shaft hoist maintenance room

- CH waste handling area

- RH waste handling area

- WHB mechanical equipment room

- Waste handling shaft hoist tower

- Exhaust filter building

The waste shaft hoist maintenance room is outside the CA and the ventilation system that serves this area is not expected to contain radioactivity. The ventilation systems for the WHB and Exhaust Filter Building are "once through" systems designed to provide confinement barriers with the capability to limit the extent of releases of airborne radioactive contaminants. The ventilation systems are also designed to provide the necessary heating, ventilating, and air conditioning for personnel comfort and to remove heat.

The WHB ventilation system continuously filters the exhaust air from waste handling areas to reduce the potential for release of radioactive effluents to the environment. Some of air from the waste handling areas can flow down the waste shaft.

The design provides for differentials to be maintained between building interior zones and the outside environment, maintaining control of potentially contaminated air. The pressure differentials between different interior potential for contamination areas are based on the design contamination zone designations with respect to function and permitted occupancy. ERDA 76-21[3] is used as a guide in establishing zone differential pressures.

The ventilation systems supply 100 percent outside air conditioned to provide a suitable environment for equipment and personnel. Design air quantities limit the spread of airborne radioactive contaminants and maintain design temperatures.

Sufficient exhaust capacity and appropriate controls in the hot cell and canister transfer cell of the WHB maintain an average velocity of at least 125 linear ft/min (0.635 m/s), through maximum credible openings to capture potential airborne contaminants. The exhaust rate for chemical hoods is sufficient to maintain an average velocity of 150 ft/min (0.762 m/s)across the hood.

The design provides for “air locks” in the following circumstances:

- At entrances to potentially contaminated areas to maintain a static barrier

- Between areas of large pressure differences to provide a pressure transition and to eliminate high air velocity, dust entrainment, and eddy currents

- Between areas where pressure differentials must be maintained

- To minimize air movement from the WHB to the waste shaft

The ventilation systems are designed to provide adequate instrumentation monitoring the operating parameters. The following parameters are monitored:

- Pressure drop across each prefilter and HEPA filter bank

- Airflow rates at selected points, e.g., downstream of the filters

- Pressure differentials surrounding areas of high potential for contamination levels

- The radioactive material concentrations in the effluent released through the exhaust vent

Fresh air supply intakes are located away from the exhaust vent to minimize the potential for the intake and recirculation of exhaust.

The operation of the supply and exhaust fans is controlled by electrical motor interlocks to maintain the designed air flow patterns and sufficient air leakage into the building. The exhaust fans and controls are capable of being supplied by backup power in the event that normal power is interrupted.

4.4.2.1.1 CH and RH TRU Waste Handling Area

The CH and RH TRU waste handling areas are served by separate, independent ventilation systems, shown on schematic flow diagrams, Figures 4.4-1 through 4.4-3.

The supply systems are Design Class IIIB, and the exhaust systems are Design Class IIIA, with the exception of HEPA filter units and associated isolation dampers, which are Design Class II.

Fan operating status, filter bank pressure drops, airborne radioactivity levels, and static pressure differentials are monitored in the Central Monitoring Room (CMR). Excess filter pressure drops and low flows alarm in the CMR. Local readouts give flow rates and pressure differentials.

The Station C radiation effluent monitoring system has provisions for monitoring the effluent air discharged from the exhaust vent.

In the CH TRU waste handling area, the design of the battery charging area exhaust system limits the buildup of hydrogen to less than 4 percent as a result of battery recharging operations, and the charging area has a separate exhaust system with prefilters and HEPA filters. The ventilation system is designed with two 100 percent capacity exhaust fans each able to remove air from high points in the forklift battery recharging area at a rate sufficient to maintain hydrogen concentration below the lower explosive limits.

In the RH TRU waste handling area, particular design consideration is given to inhibit the potential for spreading airborne radioactive particles from the hot cell. The supply air to the hot cell room is cascaded from the surrounding RH waste handling area, and exhaust air from the hot cell passes through independent prefilters and HEPA filters before being discharged to the atmosphere via the exhaust vent. Sufficient exhaust capacity is provided to maintain the design pressure differential between the hot cell and the surroundings or to maintain at least 125 linear ft/min (0.635 m/s) inward flow through the maximum credible breach, minimizing the potential for contaminants to escape.

The supply air to the hot cell is provided using an air handling unit and a cooling coil to condition the supply air drawn in from the RH receiving area.

The waste shaft is separated from the RH waste handling area by an air lock minimizing the air movement between the RH waste handling areas and the shaft.

Major Components and Operating Characteristics - The ventilation supply and exhaust systems for each building subsystem supply air to the rooms of the areas served. Each supply air handling unit consists of filters, cooling coils, heating elements, fans with associated duct work, and controls to condition the supply air maintaining the designed temperature during winter and summer. Exhaust air is filtered and monitored by the radiation monitoring system.

Each exhaust subsystem provides a filtered air exhaust path consisting of one stage of prefilters, two stages of HEPA filters, and one 100 percent capacity exhaust fan that discharge air through the building vent at a nominal flow of 47,450 ft^3 (1,343.6 m^3) per min., which is monitored for airborne radioactivity.

In the event of a tornado, tornado dampers will **automatically** close to prevent the outward rush of air caused by a rapid drop in atmospheric pressure. Damper closure mitigates the destruction of HEPA filters and ducts by preventing a high-pressure differential from affecting the filters.

During the initial opening phases of a TRUPACT-II, the TRUDOCK Vent Hood System (VHS) will function as a local exhaust system to control potential airborne-particulate contamination through the use of industrial grade HEPA filters. Headspace gases will also be drawn into the WHB HVAC exhaust system.

Safety Considerations and Controls - The exhaust system remains functional to the extent that confinement and differential pressures are maintained, exhaust air is filtered, and during a tornado excessive flow that could cause duct damage is prevented by automatic tornado dampers.

In case of an off-site power failure, the capability exists to selectively switch one exhaust fan to the backup power system in order to continue to exhaust air in the designed flow pattern. The WIPP WP 04-ED series Facility Operations Procedures[5] provides procedures for applying backup power to the exhaust fans.

The supply and exhaust fans are designed and interlocked to maintain building pressure sub-atmospheric and maintain the design airflow pattern. During normal operation, if operating exhaust fan fails on subsystems other than the CH TRU area, the corresponding supply fan is stopped in order to prevent positive building pressure. If the operating CH area exhaust fan fails, the corresponding supply fan stops and the standby train is started manually. If a corresponding supply fan fails, the exhaust fan also stops.

Sufficient remote instrumentation is provided enabling the operator to monitor equipment from the CMR. The monitored parameters include fan operating status, filter bank pressure drop, level of radioactivity in the exhaust, and static pressure differential in areas of the hot cell, and the preparation station. Fan failure and excessive radiation levels (setpoints Alpha 40 cpm and Beta/Gamma 12,000 cpm) are annunciated and low flow (setpoint 0.2 scfm) conditions of the main exhaust fans produce an alarm in the CMR.

Filter differential pressure is displayed locally as well as in the CMR. An alarm for a pressure drop indicating filter replacement is needed actuates at a predetermined level across the HEPA filters.

Instruments and system components are accessible for, and will be subject to, periodic testing and inspection during normal plant operation.

For those HEPA filters which are on-line continuously in the WHB, the CMS monitors prefilter pressure differential (D/P) and HEPA D/P ensuring satisfactory system operation. The Exhaust Filter Building HEPA filters are normally off-line, and not subject to dust buildup during normal operation. All nuclear grade HEPA filters are tested for conformance with ANSI N510,[7] and have a combined 99.95 percent removal efficiency per stage.

4.4.2.1.2 Mechanical Equipment Room

The mechanical equipment room is maintained at a pressure slightly below atmospheric to minimize leakage of room air, which may contain airborne radioactive contaminants. Negative pressure is maintained by the same exhaust fan systems that exhaust air from the CH TRU and RH waste handling areas. This equipment room is maintained within design temperature limits for equipment and personnel.

4.4.2.1.3 Waste Handling Shaft Hoist Tower

The ventilation system provides filtration of supply air, unit heaters to prevent equipment from freezing, and a unit cooler to provide supplementary cooling of equipment in summer. Exhaust airflow is down through the tower and into the waste shaft, where it combines with incoming air from the waste shaft auxiliary air intake tunnel (Figure 4.4-3).

A pressurization system serves the air lock to the crane maintenance room at 142 ft-1 in (43.3 m) elevation and pressurizes the air lock preventing the release of potentially contaminated air from the crane maintenance room to the 142 ft-1 in (43.3 m) elevation access corridor.

4.4.2.1.4 Exhaust Filter Building

A schematic flow diagram of the Exhaust Filter Building ventilation system is shown in Figure 4.4-4.This building supports the operation of the underground ventilation system and contains the underground ventilation system filtration filters.

The function of the ventilation system in the Exhaust Filter Building, major components, operating characteristics, safety considerations, and controls, are similar to the CH TRU waste handling area in the WHB.

Each supply air handling unit in the Exhaust Filter Building consists of prefilters, an electric heating coil, and a fan to condition the air, as required to maintain the design temperature.

The Exhaust Filter Building ventilation system exhausts air from all potentially contaminated areas of the building through two filter housings, each containing a bank of prefilters and two stages of HEPA filters, and two exhaust fans before discharging to the atmosphere. The building's exhaust air is discharged to the underground exhaust duct so that it can be monitored for airborne radioactive contaminants.

4.4.2.2 Surface Support Structures Ventilation System

The following surface support facilities are served by separate heating, ventilation, and air-conditioning systems:

- The Support Building
- Main Warehouse/Shops Building
- Water Pump House
- Guard and Security Building
- Maintenance Shop
- Compressor Building (exhaust fans only)
- Safety and Emergency Services Building
- Engineering Building
- Training Building

The design of the surface support facilities HVAC systems provides for:

- Regulating temperature for the comfort of personnel and satisfactory operation of equipment
- Filtering the air supply for personnel
- Maintaining building spaces at slightly positive pressures with respect to the outside, except radioactive materials areas, where negative pressures shall be maintained relative to the outside and to adjacent accessible nonradioactive building spaces
- Confining ventilation air to designed airflow paths for discharge to the atmosphere
- Minimizing the possibility of exhaust air recirculation by an adequate distance between fresh air supply intakes and exhaust air outlets

The design of the ventilation system for the CMR requires functions to be performed with respect to environmental control for personnel and equipment following a postulated accident, such as a fire or radioactivity release. The CMR system is manually switched to the backup power supply to ensure operation monitoring, and control of the HVAC systems if the normal power supply is lost.

In addition, the independent CMR HVAC system provides for:

- 100 percent equipment redundancy (except ductwork)
- Make-up air being processed through HEPA filters in the event of a high airborne radioactivity signal
- Static pressure controls to regulate the amount of outside air that may be drawn into the system through the HEPA filters before it is supplied to the CMR permitting occupancy

Safety Considerations and Controls - The HVAC systems for these surface support facilities, with the exception of the CMR, are not required to perform functions that are essential to safety. Fan motor interlocks, dampers, temperature indicators, filter pressure differential alarms, and other required instrumentation and controls are provided.

CMR

The Support Building CMR area HVAC system serves the computer room, CMR and associated vestibule, vault, office, and storage room. Equipment redundancy is provided for the following: supply air handler, air cooled condensing unit, and exhaust fan.

The HVAC system provides a suitable environment for continual personnel occupancy, and equipment integrity under normal and emergency conditions and maintain a slightly positive pressure in the CMR. Air passes through at least a two-stage filtration system before it enters the above listed areas.

A HEPA filter and pressurizing fan system upstream of the supply units, bypassed during normal operation, may be automatically activated upon the detection of airborne radioactivity levels above the sensor set point at Station C.

Major Components and Operating Characteristics - Major components of this HVAC system consist of supply air handling units (containing fans, direct expansion cooling coils, and filters), air cooled condensing units, duct heaters, exhaust-return fans, booster fans, HEPA filter units, dampers, instrumentation, and controls.

The schematic airflow diagram for the CMR area HVAC system is shown in Figure 4.4-5.

The CMR area is served by two 100 percent capacity air-conditioning units. One in service and one in standby status, available for automatic start in the event the operating unit fails.

Under normal operating conditions (recirculation mode), outside makeup air and return air are filtered by a two-stage air filter system. The first stage of filtration consists of nominal 2-inch (5 cm) thick low efficiency filters and the second stage consists of high efficiency filters rated at 85 percent efficiency (atmospheric dust) by ASHRAE Standard 52-76.[8] After the second stage of filtration, the air supply temperatures are thermostatically controlled, as necessary to maintain designed temperatures. The filtered and conditioned air supply is distributed to the various rooms within the CMR area by means of ductwork and air outlets.

Safety Considerations and Controls - The main function of the HVAC system is to provide a suitable environment enabling the CMR area to be occupied under normal and emergency operating conditions including the prevention of airborne radioactive contaminants entering the supply systems.

A backup air conditioning system (air handler, air cooled condensing unit, and exhaust fan) is available to automatically start in the event an operating component fails. The supply and exhaust air handling systems are capable of being manually connected to the backup power system for operation during a loss of off-site power.

Locally-mounted instruments are provided for monitoring the HVAC system and filter pressure drop is monitored and alarmed, locally and in the CMR.

The supply and return exhaust fans are electrically interlocked, to maintain the designed airflow pattern, and the entire HVAC system is interlocked with the fire protection system.

4.4.2.3 Subsurface Facilities Ventilation System

The subsurface ventilation system serves all underground facilities and provides confinement of radioactivity, acceptable working conditions, and a life-sustaining environment during normal operational occurrences and postulated waste handling accidents. Operation of diesel equipment in the underground repository is limited to the available airflow in the area.

Subsurface ventilation is divided into four independent flow paths on the disposal horizon supporting the waste disposal area, the mining area, north area, and the waste shaft and waste shaft station area. The waste disposal, and mining and underground shop areas receive their air supply from common sources (see Figure 4.4-6) (the AIS and the SH shaft) and are independent of each other after the initial distribution/split is made. The waste shaft station receives its air supply from the waste shaft and is kept completely isolated from the other three. All four air circuits combine near the exhaust shaft, which acts as the common discharge from the system.

All bulkheads and ventilation controllers used to maintain the integrity of the underground ventilation circuits are made of fire resistant material, and can support the maximum pressure differential that could occur under normal operating conditions. These structures are designed, installed, and maintained in such a manner that they can accommodate the ground deformation (salt creep) occurring in the underground.

One of three filtration surface exhaust fans is capable of being connected to the backup power supply (one at a time) in the event that normal power is lost. Changeover to backup power is manual. The ventilation system is instrumented to provide for verification of proper system function.

The design and operation of the underground ventilation system meets or exceeds the criteria specified by 30 CFR 57[9] and the New Mexico Mine Safety Code for All Mines.[10] The underground mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. During normal operating mode (simultaneous mining and waste emplacement operations), approximately 140,000 actual ft^3 (3,962 m^3) per min can be supplied to the panel area. This quantity of air is required to support the numbers and types of diesel equipment that are expected to be in operation in the area, to support the underground personnel working in that area, and to exceed a minimum air velocity of 60 ft (18 m) per min, as specified in the WIPP Ventilation Plan .

Approximately 35,000 ft^3 (990 m^3) per min will be required in each of three active rooms during operations. This quantity of air is required to support the numbers and types of diesel equipment that are expected to be in operation in the area, to support the underground personnel working in that area, and to exceed a minimum air velocity of 60 ft (18 m) per min, as specified in the WIPP Ventilation Plan. The remaining rooms in a panel will either be completely filled with waste; be idle, awaiting waste handling operations; or being prepared for waste receipt. The remainder of the air is needed in order to account for air leakage through inactive rooms and support facilities.

Air will be routed into a panel from the intake side. Air is routed through the individual rooms within a panel using underground bulkheads and air regulators. Bulkheads are constructed by erecting framing of rectangular steel tubing and screwing galvanized sheet metal to the framing. Figure 4.4-8 shows a typical bulkhead with an airflow regulator installed. In order to accommodate salt creep, bulkheads use telescoping extensions that are attached to the roof. Bulkheads use either a sheetmetal or rubber flashing attached to the salt to provide an effective seal. Flow is also controlled using brattice cloth barricades. These consist of chainlink or other suitable materials fence that is bolted to the salt and covered with brattice cloth; and are used in instances where the only flow control requirement is to block the air temporarily. Ventilation will be maintained only in active rooms within a panel. After all rooms within a panel are filled, the panel will be closed using a closure system described in Section 4.2.3.4.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by constructing chain link/brattice cloth barricades at each end. A brattice cloth air barricade is shown in Figure 4.4-9. There is no requirement for air for these rooms since personnel and/or equipment will not be in these areas.

The ventilation path for the waste disposal side is separated from the mining side by means of air locks, bulkheads, and salt pillars. A pressure differential is maintained between the mining side and the waste disposal side to ensure that any leakage is towards the disposal side. The pressure differential is produced by the surface fans in conjunction with the underground air regulators. Pressure differentials across these bulkheads between the mining and disposal sides (located nearer to the disposal panel) are monitored from the CMR.

The exhaust air is discharged through the exhaust shaft, by the exhaust system, under the following modes of operation:

<u>Normal Mode</u> - During normal operation, four different levels of Normal Mode ventilation can be established to provide four different air flow quantities as follows:

- Normal Ventilation: Two main exhaust fans operating to provide 425,000 scfm (224 m^3/s) unfiltered.
- Alternate Ventilation: One main exhaust fan operating to provide 260,000 scfm (123 m^3/s) unfiltered.

- Reduced Ventilation: Two filtration fans operating as ventilation fans to provide 60,000 scfm (28.3 m^3/s) each unfiltered.

- Minimum Ventilation: One filtration fan operating as a ventilation fan to provide 60,000 scfm (28.3 m^3/s) unfiltered.

- Maintenance Ventilation: Simultaneous operation of one main ventilation fan with one or two of the filtration fans in support of flow calibration and maintenance activities.

Filtration Mode - This mode mitigates the consequences of a waste handling accident by providing a HEPA filtered air exhaust path from the waste disposal areas and also reducing the air flow. Manual activation is required if the CMR is notified of an underground occurrence involving the waste packages. This mode may also be activated automatically by the Radiation Monitoring System active waste disposal room exit alpha CAM.

Fire Isolation Mode (Air Reversal Mode) - An underground fire or an emergency may necessitate air reversal in the affected area(s). The system provides air reversal modes in the mining area, the AIS and station, and the SH shaft and station, and Underground Shop (north) area. In these modes, the air is reversed by opening and closing certain ventilation doors and air regulators, and by operating the underground reversal fans in either forward or reverse direction. The surface exhaust fans will be stopped prior to attempting any air reversals underground. The AIS and SH Shaft may each be isolated by control doors on either side of the shaft during abnormal operation.

The ventilation system is designed as an exhausting system that maintains the working environment below atmospheric pressure. Schematic diagrams of the underground ventilation system are presented in Figures 4.4-6 and 4.4-7. All underground flows join at the bottom of the Exhaust Shaft before discharge to the atmosphere.

Outside air will be supplied to the mining areas, and the waste disposal areas and the North U/G Shop area through the Air Intake Shaft, the Salt Handling Shaft, and access entries. A relatively small quantity of outside air will flow down the Waste Shaft to ventilate the Waste Shaft station. The ventilation system is designed to operate with the Air Intake Shaft as the primary source of fresh air. In Normal Ventilation Mode, sufficient air will be available to simultaneously conduct all underground operations (e.g., waste handling, mining, and support).

If the nominal flow of 425,000 scfm (224 m^3/s) is not available, underground operations may proceed, but the number of activities that can be performed in parallel may be limited depending on the quantity of air available. Ventilation may also be achieved by operating one main fan (Alternate Ventilation Mode), or either one or two of the filtration fans (Minimum and Reduced modes respectively). To accomplish this, the isolation dampers will be opened, which will permit air to flow from the main exhaust duct to the filter outlet plenum. The filtration fans may also be operated to bypass the HEPA plenum. The isolation dampers of the filtration exhaust fan(s) to be employed will be opened, and the selected fan(s) will be switched on. ln this mode, underground operations will be limited.

Shift from normal flow to Filtration mode has been tested and it was demonstrated that a reverse pressure pulse was generated upon closure of the main exhaust fan inlet dampers. This reverse pressure pulse results in reverse flow temporarily in select portions of the underground system. Testing has further demonstrated that the reverse pressure/flow phenomena is greatly lessened if main fan coast down is allowed for a period of time prior to isolation. Modifications have been made that cause the main fan isolation dampers to close slowly, when the main exhaust fans are shut down, to minimize any pressure pulse back through the system.

In the filtration mode, the exhaust air will pass through two identical filter assemblies, with only one of the three Exhaust Filter Building filtration fans operating (all other fans are stopped). This system provides a means for removing the airborne particulates that may contain radioactive and hazardous waste contaminants in the reduced exhaust flow before the air is discharged through the exhaust stack to the atmosphere. The filtration mode is activated either manually or automatically if the radiation monitoring system detects abnormally high concentrations of airborne radioactive particulates. Shifting of the exhaust system to the filtration mode can be accomplished manually, either locally at the exhaust filtration building, or by the CMR operator. A high alarm condition from a Radiation Monitoring System active waste disposal room CAM, 75 CPM alpha, or 7,500 CPM beta/gamma, will cause an automatic shift of the mine exhaust air from unfiltered to filtered mode, System Design Description SDD-RM00.[4] The reduced exhaust flow is diverted to the HEPA filters by isolation and diversion dampers on the exhaust fans and duct work preventing unfiltered flow escaping to the atmosphere. The filtration mode is not initiated by the release of gases such as VOCs.

Provisions are included for detecting airborne radioactive contaminants in the waste disposal areas, in the waste shaft and station, and in the discharge to the surface exhaust vent.

Major Components and Operating Characteristics - The ventilation system consists of six centrifugal exhaust fans (three in the normal flow path and three in the filtration flow path), two identical HEPA filter assemblies arranged in parallel, isolation and back draft dampers, filter bypass arrangement, and associated ductwork. Operation of the underground ventilation system is detailed in the WIPP WP 04-VU series Facility Operations Procedures.[6]

The six fans are divided into two groups. One group consists of three fans, which are used during normal operation to provide an underground flow of 425,000 scfm (224 m^3/s), and are located near the exhaust shaft. One main fan can be operated to provide 260,000 scfm (123 m^3/s). The remaining three fans, rated at 60,000 scfm (28.3 m^3/s) each, are located at the Exhaust Filter Building, and are capable of being used during the filtered mode of operation. This mode of operation requires the use of only one of the three fans at any given time with all other fans stopped and isolated. Two of the three filter mode fans can also be operated (with the HEPA system bypassed) to provide other underground ventilation requirements, when needed.

Each filter assembly consists of two banks of prefilters and two banks of HEPA filters arranged in series; and, each assembly will handle 50 percent of the filtered mode airflow (30,000 cfm each [14.2 m^3/s]).

Any one of the three Exhaust Filter Building fans is capable of delivering 100 percent of the design flow rate with all filters at their maximum pressure drop. Fan failure is monitored by a flow sensing device on the fan's discharge side, and alarms in the CMR.

Safety Considerations and Controls - The operating status of the exhaust fans and the airborne contamination level of the effluent discharged are displayed in the CMR. Provides a means to switch to filtration.

An alarm for excessive pressure drop across the filters is actuated at a predetermined level. Filter differential pressure is displayed locally and in the CMR.

Instruments and system components are accessible for periodic testing and inspection during normal plant operation. Under normal operating conditions, the ventilation system functions continuously.

4.4.2.3.1 Natural Ventilation Pressure

The air flow in the underground is normally driven by the negative pressure induced by the exhaust fans. There can be a second pressure resulting from the difference in density between the air entering and leaving the repository which can influence airflow. This phenomenon is called the natural ventilation pressure (NVP). It is experienced on days when outside temperatures are either very hot or very cold.

Hot Weather NVP - During hot weather, the air going down to the underground is warmer and less dense (lighter) than the air returning from the underground. This lighter air has a natural tendency to resist being drawn down into the repository (hot air rises). Hence in hot weather there is a (negative) NVP which opposes the fan pressure. This reduces the flow down the AIS and SH shaft. It also reduces the differential pressures between the waste shaft station, waste disposal area, and the other areas. The air in the waste shaft will be cooler than that in the AIS and SH shaft, which further reduces the waste shaft station to W30 differential pressure. (See Figure 4.1-3 for U/G locations).

Under ordinary operating conditions, the pressure in W30 is higher (less negative) than that in the waste shaft station (S400). On very hot days (exceeding 100 degrees F [37.8 degrees C]) the reduction of this differential pressure caused by the negative NVP can result in the pressure in S400 being higher than in W30. Without corrective actions, this would allow airflow from the CA area into a non-CA area.

Cold Weather NVP - During cold weather, the air going down to the underground is colder and denser (heavier) than the air returning from the underground. This denser air has a natural tendency to sink down the AIS and SH shaft (cold air sinks). In cold weather there is a positive NVP which augments the fan pressure. This increases the airflow down the intake shafts, reduces the fan suction pressure (constant flow control) and increases the differential pressure between the waste shaft station, waste disposal area, and the other areas.

The WIPP mine ventilation system is designed for intake air to downcast in the AIS, SH shaft, and waste shaft. The system pressure required to induce those down drafts is supplied by the surface fans. On extreme cold weather days, a portion of the air entering the repository through the AIS and SH shaft may be the result of a positive NVP. This air is entering the repository <u>without</u> the aid of the mechanical fans. The fans in turn reduce their operating pressure because they are receiving a sufficient and constant volume of air. Upcasting of the air in the waste shaft can occur if the situation is not corrected.

The air feeding the waste shaft comes primarily from the auxiliary air intake tunnel, partly from leakage into the waste hoist tower, and partly from the Waste Handling Building. The result is that the air feeding the waste shaft tends to be warmer than the surface air feeding the AIS. The reduction in fan pressure, coupled with the warmer air in the waste shaft is only under alternate, reduced, and minimum ventilation modes.

Administrative action is required to adjust the underground ventilation configuration to avoid reverse flow in the waste shaft. There are several alternatives which can be performed concurrently to prevent or correct this problem should it occur. They include:

- Start second main exhaust fan (normal ventilation).
- Open the regulator to the waste shaft station.
- Cover the AIS and/or the SH shaft on the surface.
- Close the regulators to the mining, waste disposal and experimental areas.

A pressure chamber has been constructed on the west side of the waste shaft station to ensure that leakage from the CA side into the non-CA area does not occur. The pressure chamber is manually activated whenever waste handling is occurring in the waste shaft and/or waste shaft station, and differential pressure between S400 and W30 is low. The chamber is pressurized by six high pressure fans. The fans are operated in various combinations to provide the airflow necessary to maintain the pressure buffer. As a secondary backup system, pressure will be supplied by an actuated valve on a plant air pressurized line. The valve will be controlled by a Foxboro controller to regulate the flow of air into the chamber and maintain pressure differentials. The pressure inside the chamber is monitored to ensure that it is sufficient to prevent airflow reversal even if the differential pressure from S400 to W30 (which is also monitored) is in the wrong direction or positive NVP is sufficient to cause waste shaft reversal.

References for Section 4.4

1. DOE Order 6430.1A, General Design Criteria, April 1989 (For reference only, superceded by DOE O 420.1 and DOE O430.1A).

2. DOE Order 5400.5, Radiation Protection of the Public and the Environment, June 1990. (Latest is Change 2, January 7, 1993).

3. Energy Research and Development Administration, 76-21.

4. SDD-RM00, Radiation Monitoring System, Rev. 3, August 1997.

5. WIPP 04-ED series Facility Operations Procedures.

6. WP 04-VU, WIPP series Facility Operations Procedures.

7. ANSI N510, American National Standards Institute, Standard for Testing of Nuclear Air Cleaning Systems.

8. ASHRAE, Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter, 52-76.

9. 30 CFR 57, Safety and Health Standards - Underground Metal and Nonmetal Mines, 8th edition, 1994.

10. New Mexico Mine Safety Code for All Mines, 1990.

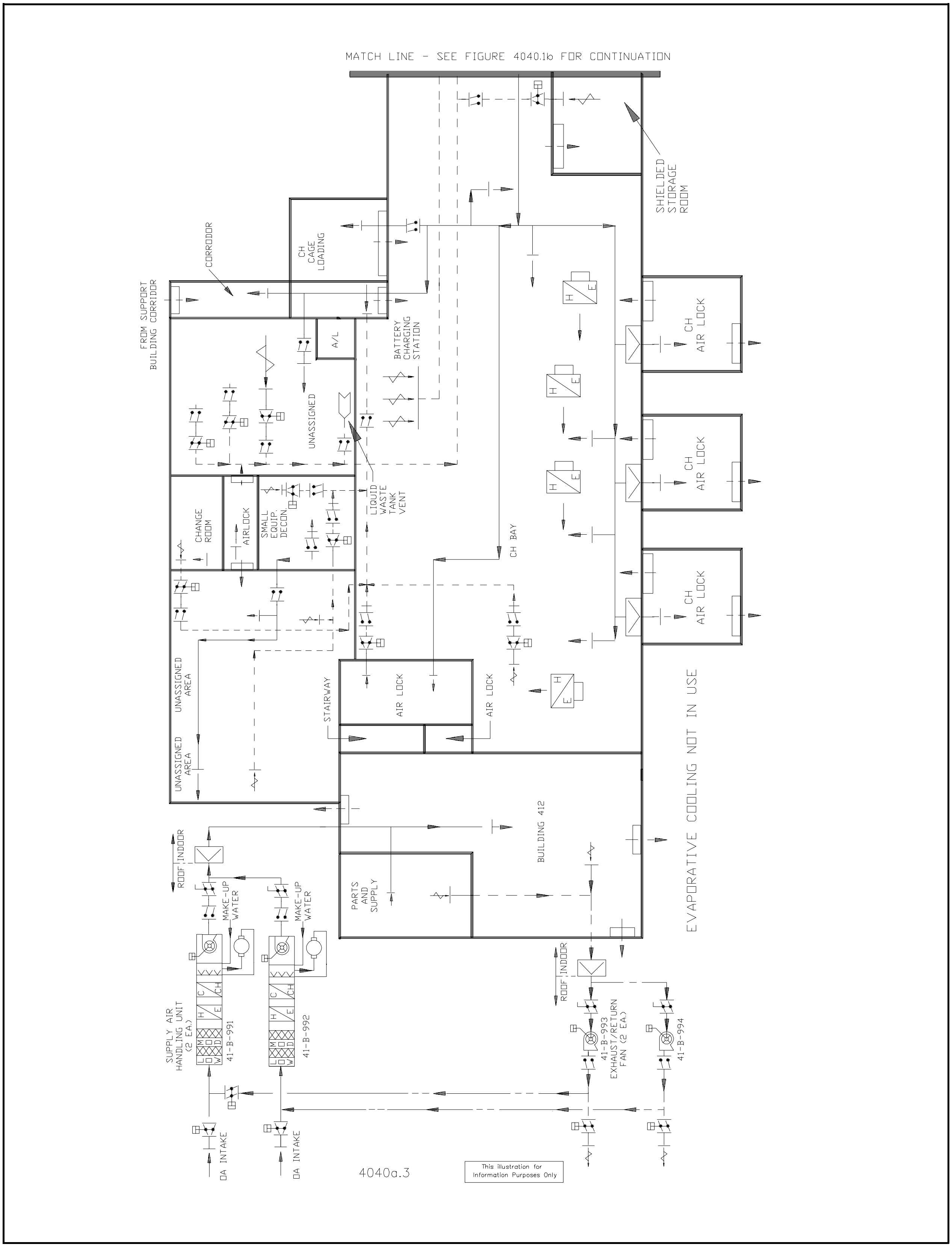

Figure 4.4-1a, WHB and TRUPACT Maintenance Facility

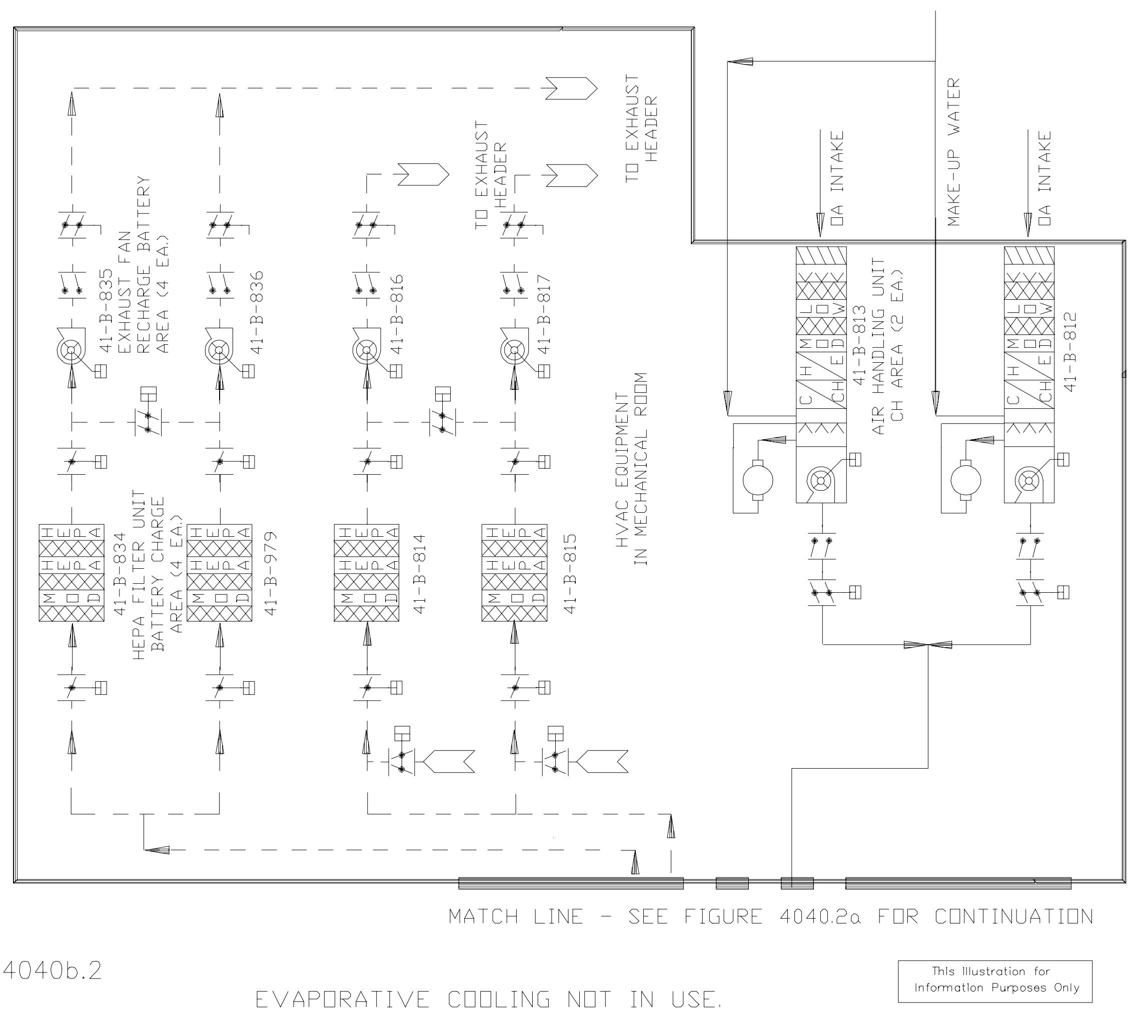

Figure 4.4-1b, Waste Handling Building

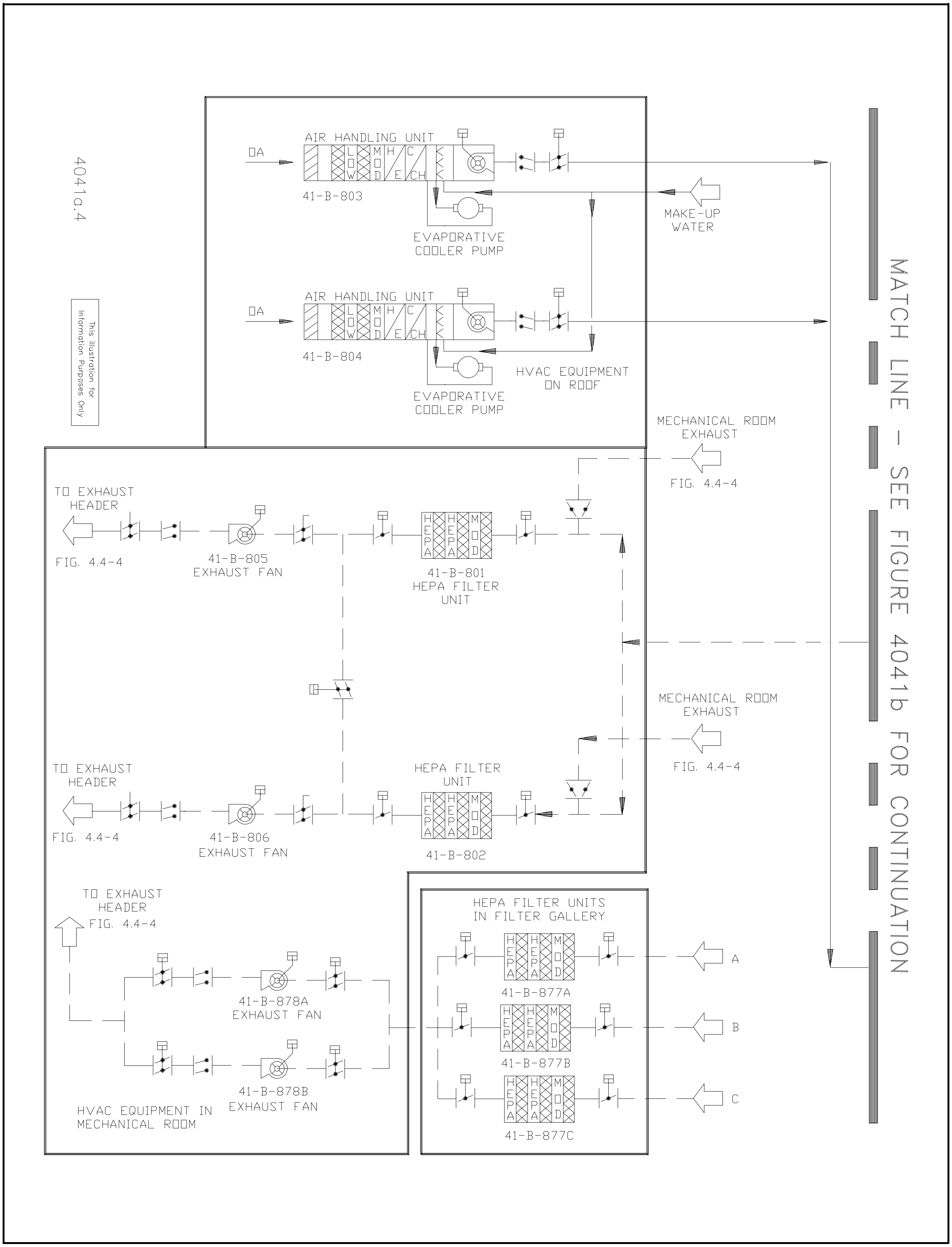

Figure 4.4-2a, WHB RH Handling HVAC Flow Diagram

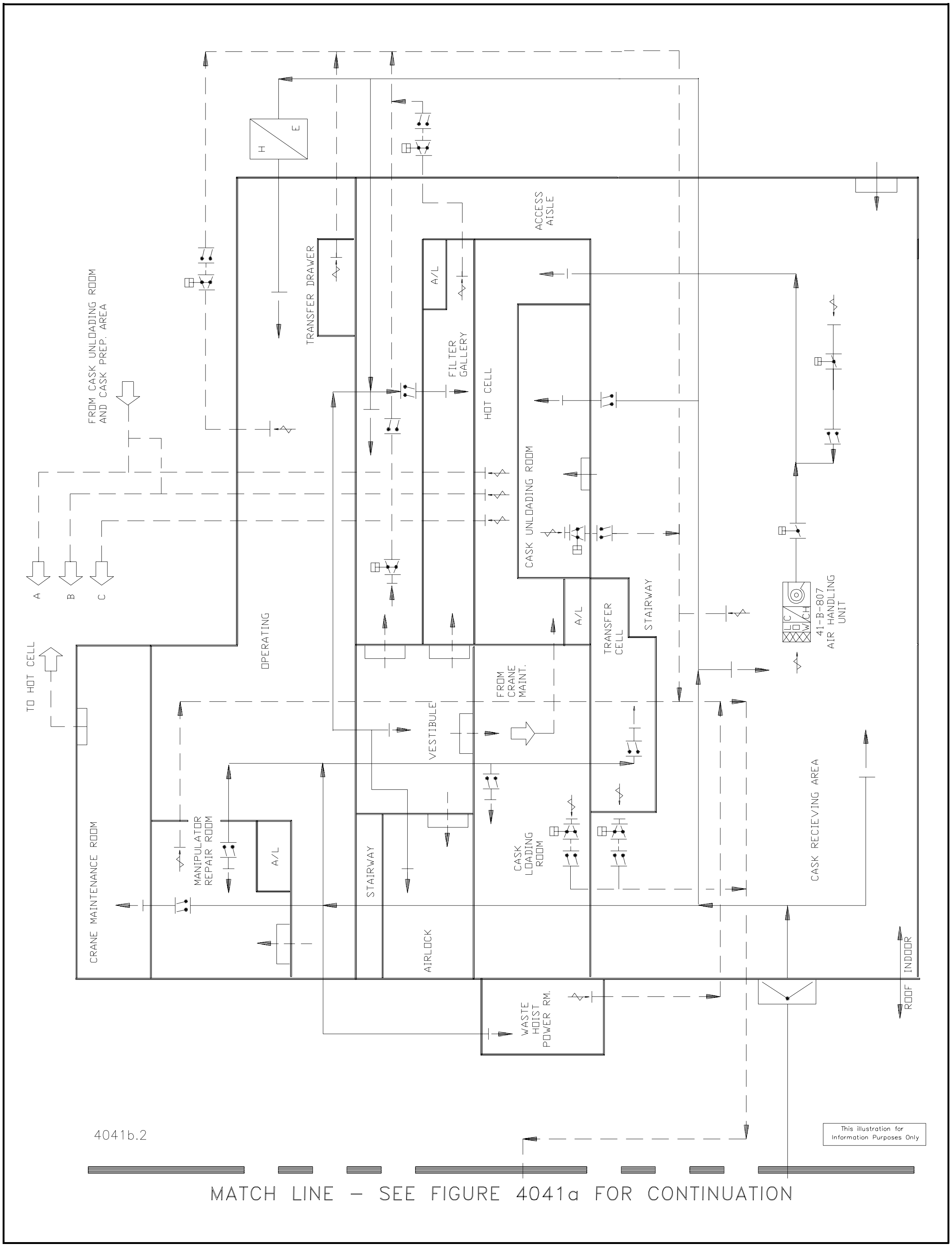

Figure 4.4-2b, WHB RH Handling HVAC Flow Diagram

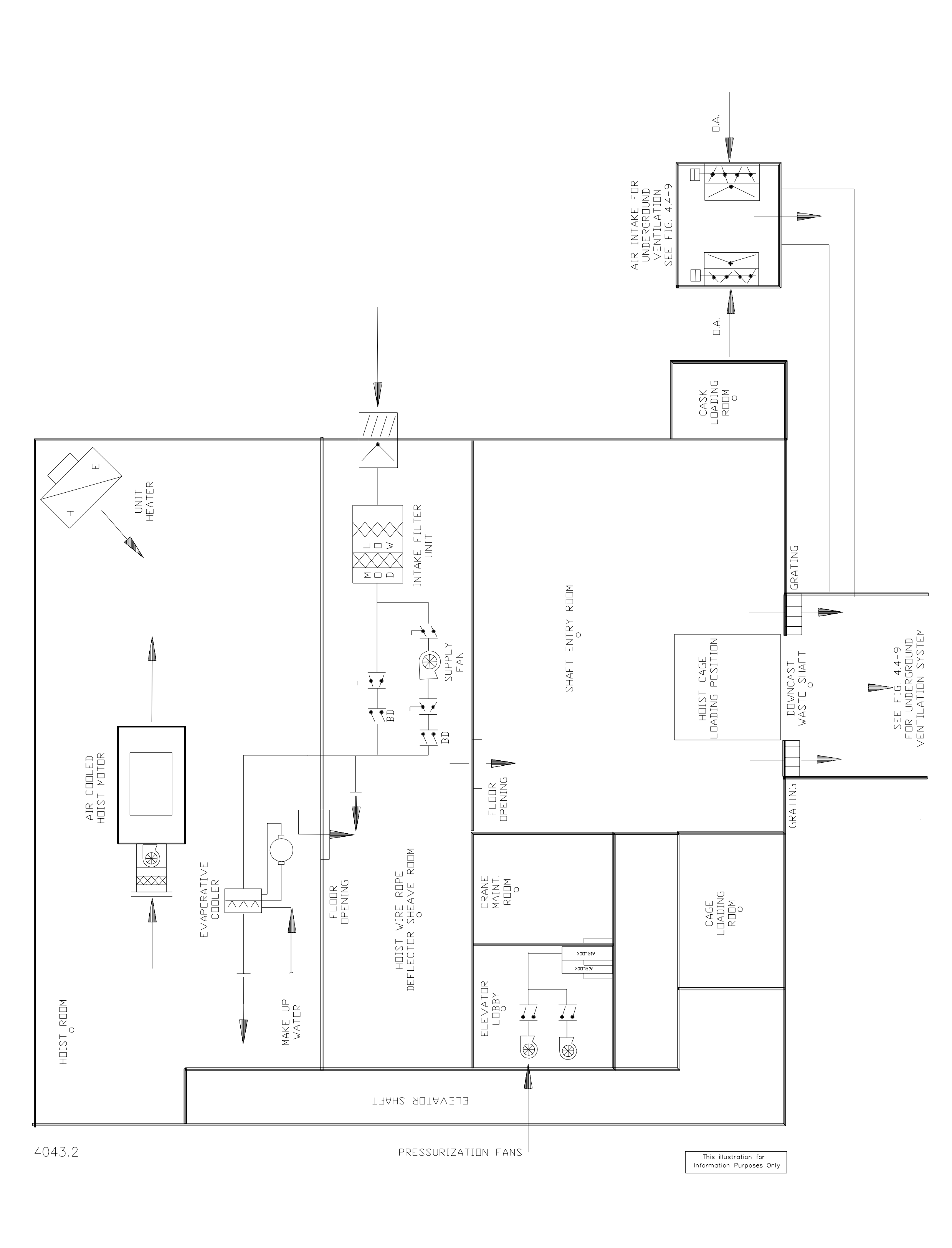

Figure 4.4-3, Waste Handling Shaft/Hoist Tower HVAC System Flow Diagram

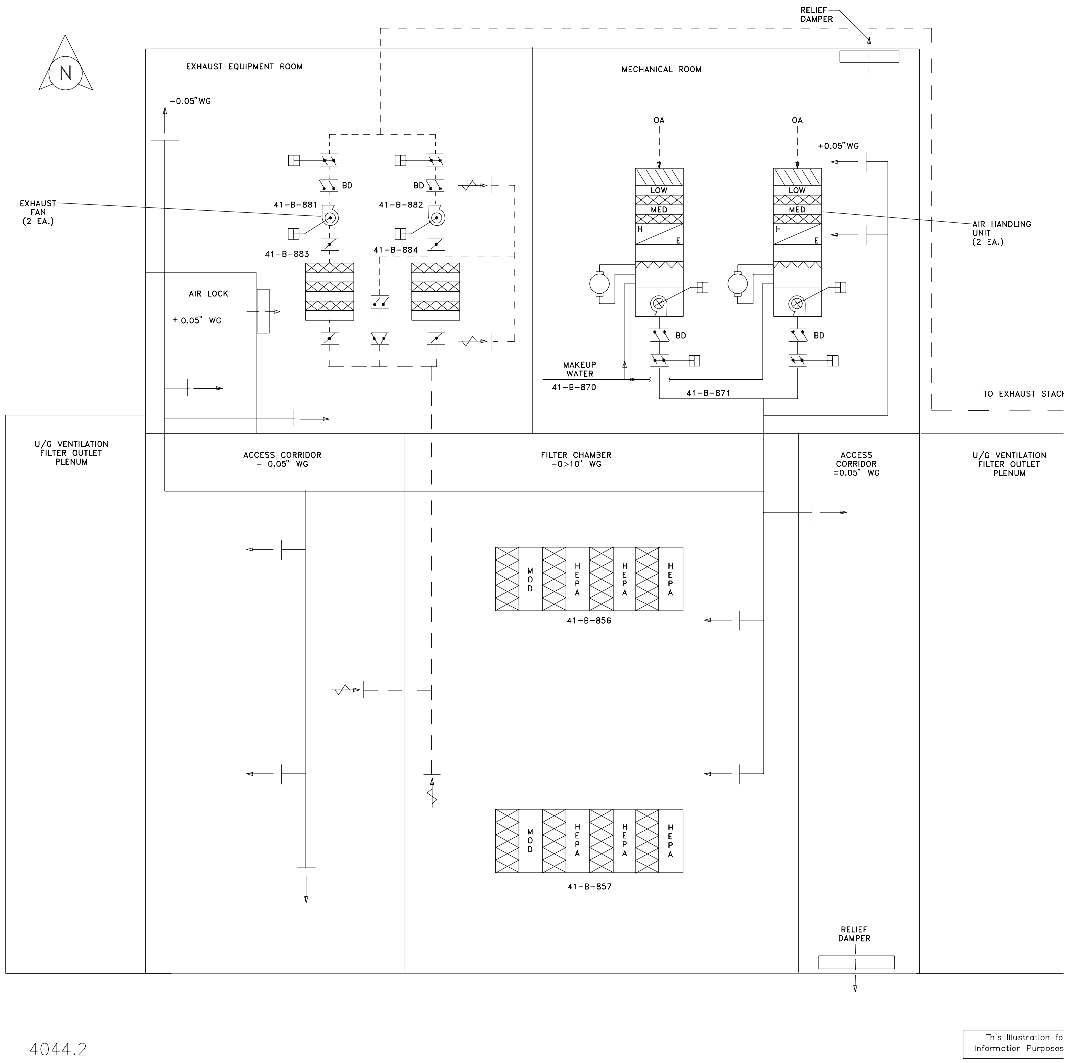

Figure 4.4-4, Exhaust Filter Building HVAC Flow Diagram

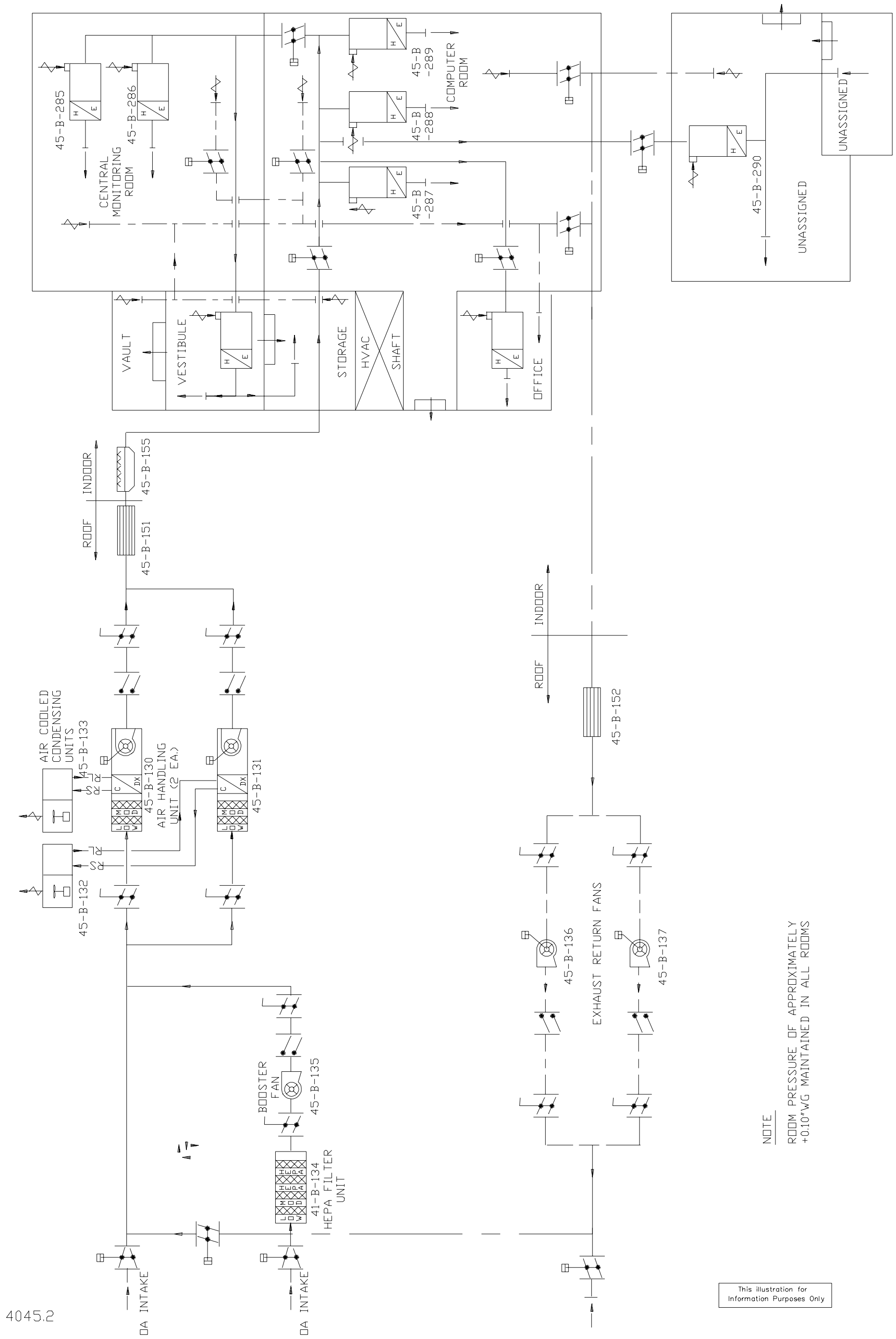

Figure 4.4-5, Support Building CMR Area HVAC Flow Diagram

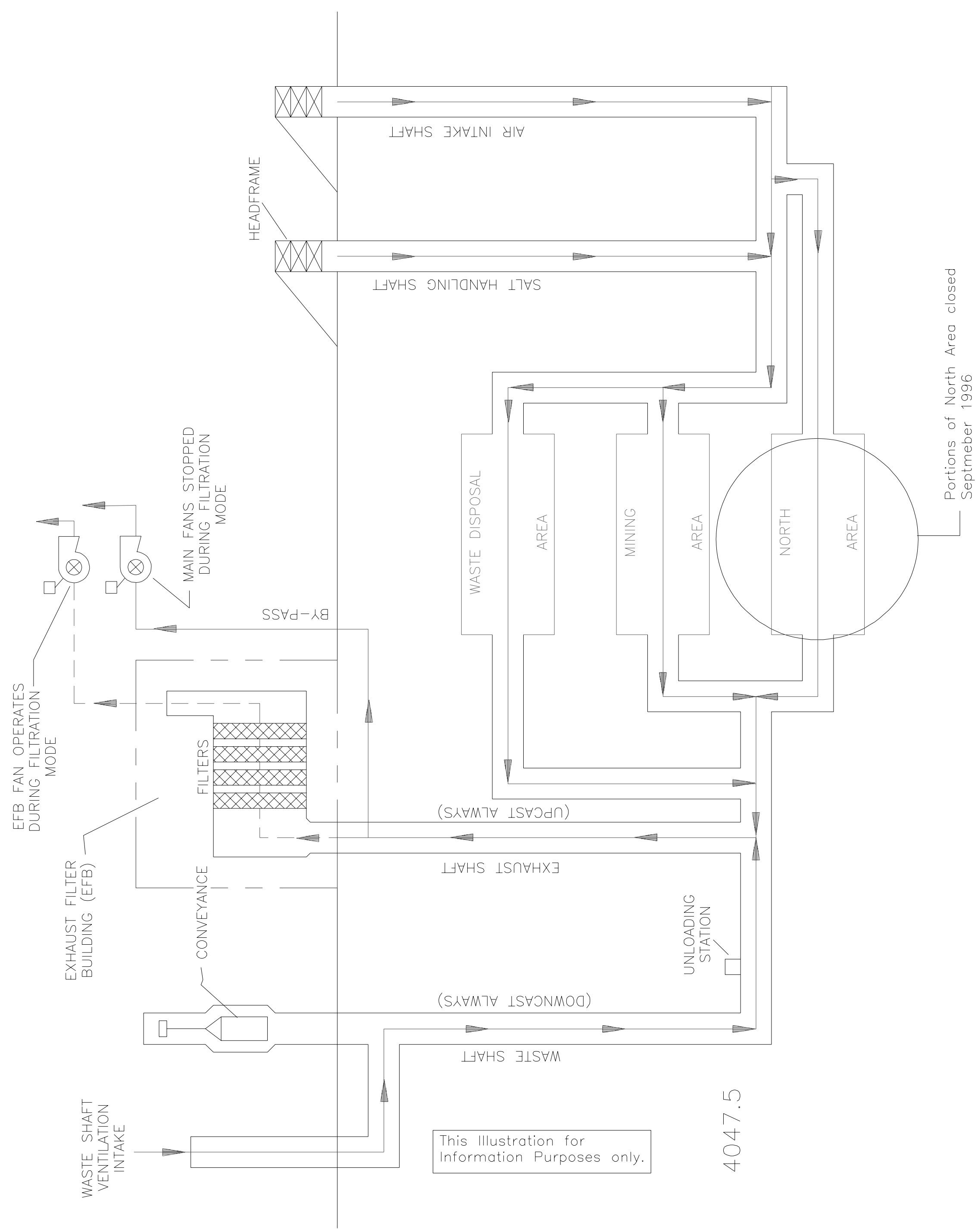

Figure 4.4-6, Underground Ventilation Air Flow Diagram

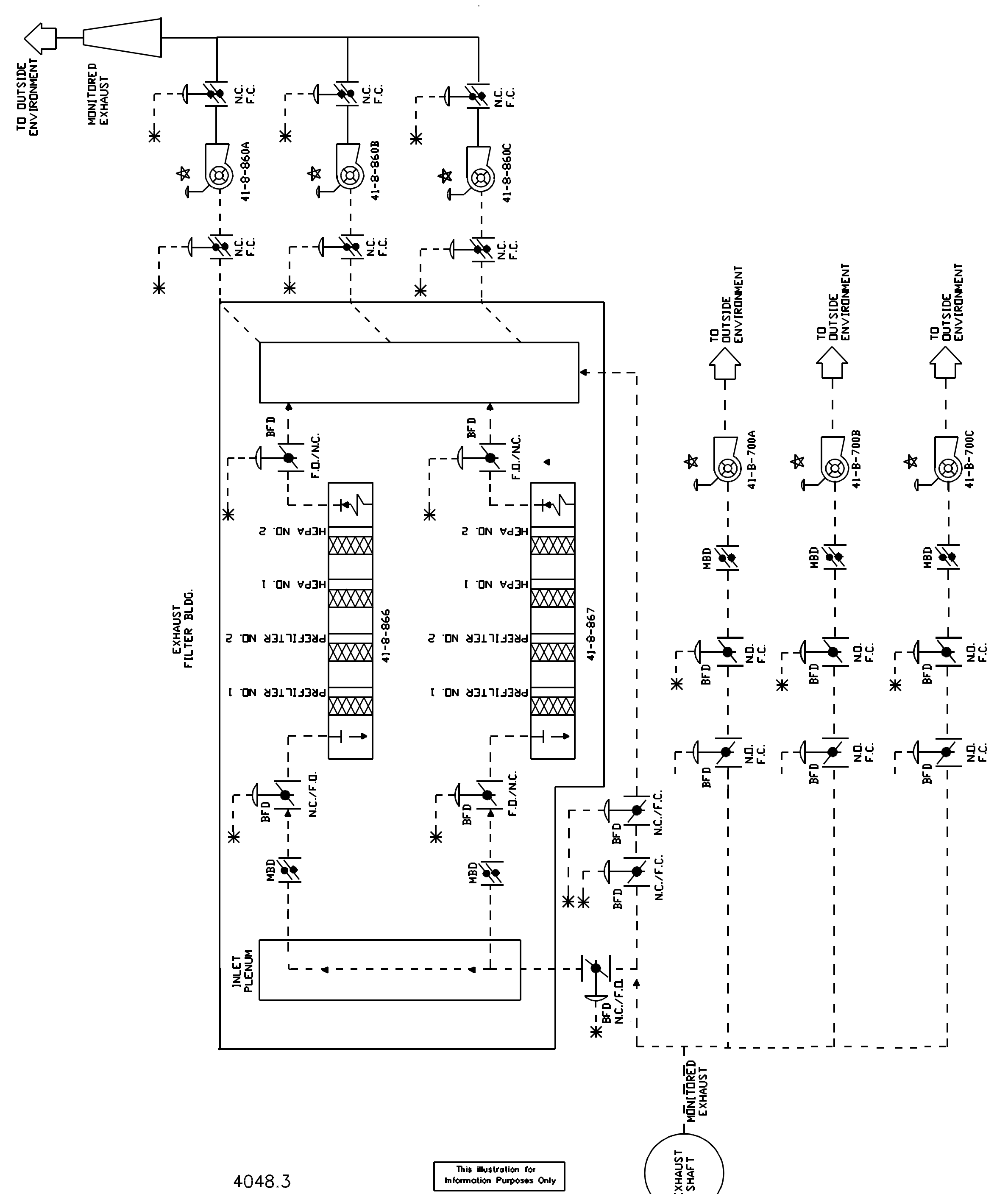

Figure 4.4-7, Main Fan and Exhaust Filter System Schematic

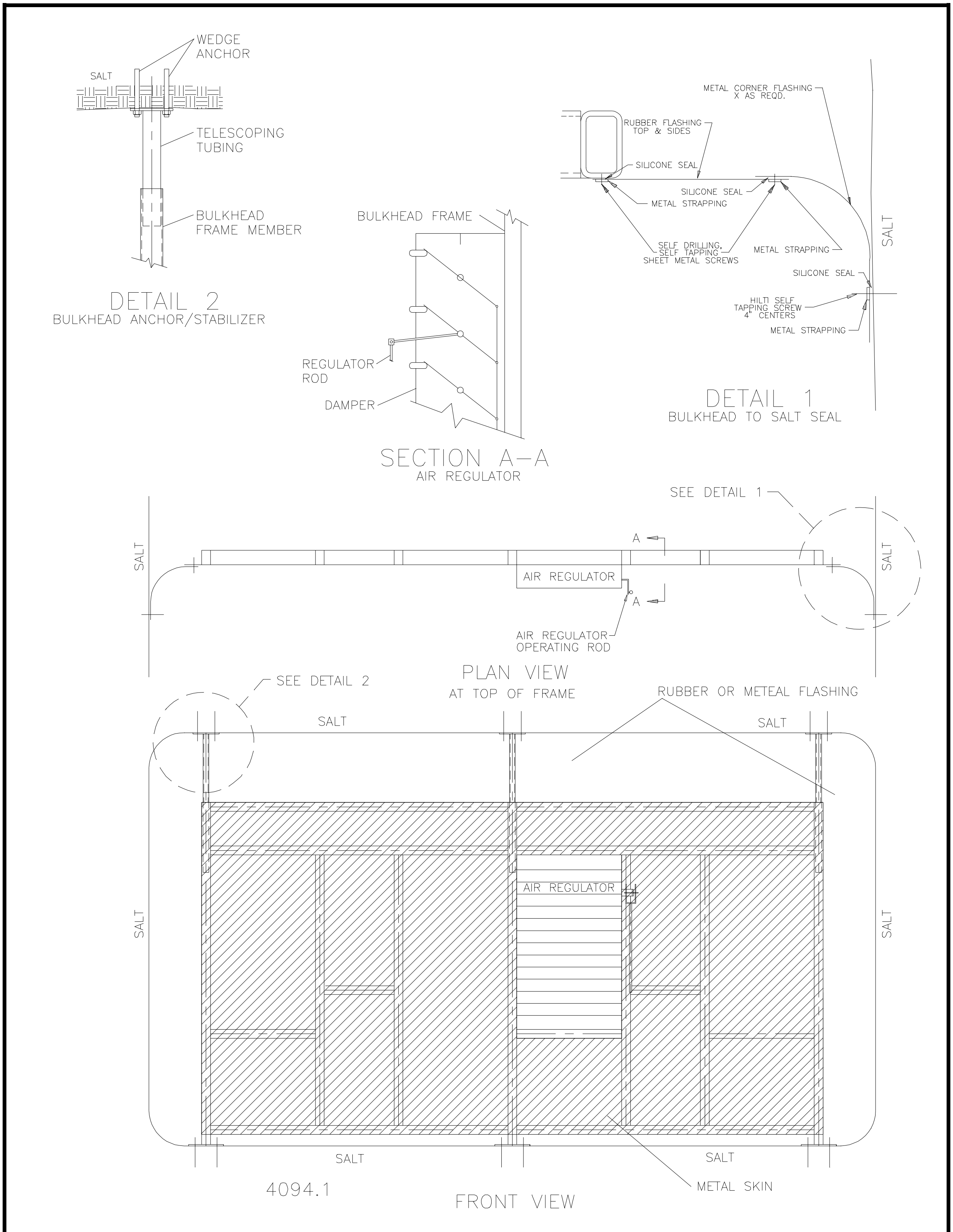

Figure 4.4-8, Typical Bulkhead Design and Components

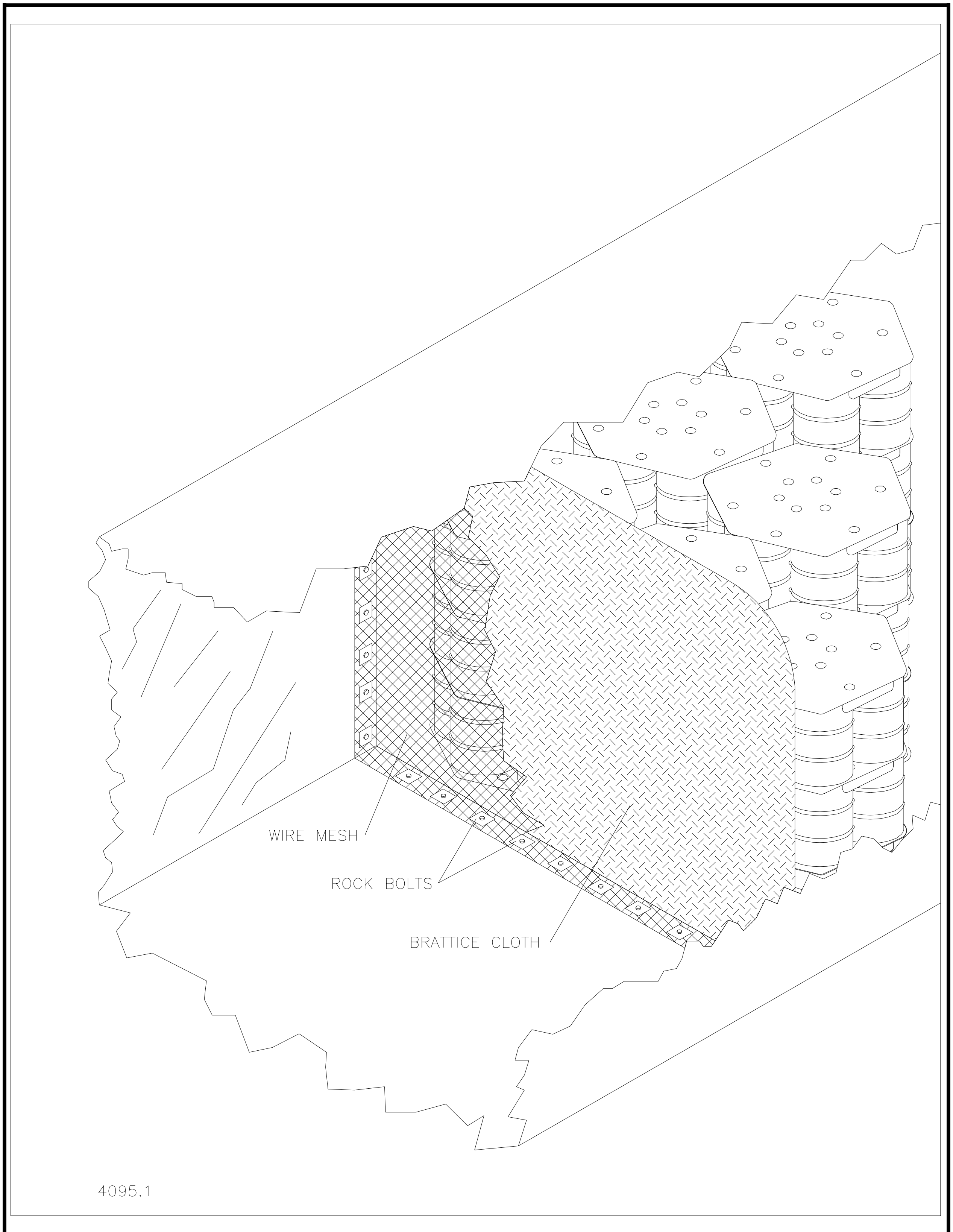

Figure 4.4-9, Typical Room Barricade

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4.5 Safety Support Systems

4.5.1 Fire Protection System

The WIPP fire protection system is designed to ensure personnel safety, mission continuity, and property conservation. Building designs incorporate features for fire prevention (e.g., control and extinguishment) Also, fire hazards are controlled throughout the WIPP. The plant design meets the "improved risk" level of protection defined in DOE 5480.7A[1] and satisfies the applicable sections of the National Fire Protection Association codes, DOE Orders, and federal codes to the extent described in WIPP-WID-96-2176, *WIPP Fire Hazard Analysis Report*.[2]

To meet these objectives, the WIPP facility design incorporates the following features:

- Most buildings and their support structures are protected by fixed, automatic fire suppression systems designed to the specific, individual hazards of each area.
- Noncombustible construction, fireproof masonry construction, and fire resistant materials are used whenever possible.
- Fire separations are installed where required because of different occupancies per the Uniform Building Code (UBC).
- In buildings where compartmentation is required, vertical openings are protected by enclosing stairways, elevators, pipeways, electrical penetrations, etc., to prevent fire from spreading to upper floors.

The exhaust ventilation systems which remove hot fire gases, toxic contaminants, explosive gases, and smoke are designed with a high fire integrity. The subsurface and surface structures are served by these systems.

The components of the electric service and distribution systems are listed by Underwriters' Laboratory, or approved by Factory Mutual Engineering Corporation, and are installed to minimize possible ignition of combustible material and maximize safety.

Adequate provisions for the safe exit of personnel are available for all potential fire occurrences with evacuation alarm signals provided throughout occupied areas.

Building evacuation plans help ensure the safe evacuation of building occupants during emergency conditions. The WIPP Emergency Management Program[3] contains the underground emergency procedures, the underground evacuation routes, and the designated assembly areas.

The WIPP Fire Protection System consists of four subsystems. They are:

- Fire Water Supply and Distribution System
- Fire Suppression System
- Fire Detection and Alarm System
- Radio Fire Alarm Reporter (RFAR) System

All fire protection systems are classified as Design Class IIIB.

4.5.1.1 System Descriptions

The WIPP facility fire protection systems service the WHB, the support structures, and the underground support areas.

4.5.1.1.1 Fire Water Supply and Distribution System

The Fire Water Supply and Distribution System consists of two fire pumps, a pressure maintenance (jockey) pump, and a compound loop yard distribution system. One fire pump is electric motor driven and the other pump is diesel engine driven. Both pumps are rated for 1,500 GPM (5678 LPM) at 125 psi (8.8 kg/cm^2). The system is required to provide fire water at a rate of 1,500 GPM (5678 LPM) for two hours (180,000 gallons [681,354 L]).

The Fire Water Supply System receives its normal water supply from one of two on-site 180,000 gallon (681,354 L) ground-level storage tanks, which are part of the Water Distribution System. The second tank supplies water to the Domestic/Utility Water System, which is a separate system from the Fire Water Supply System, and also reserves approximately 100,000 gallons (378,540 L) of water for use as fire water. Utilization of the water in the second tank by the Fire Water Supply System is achieved by the installation of a suction piping spoolpiece.

Operation of the two fire pumps and the jockey pump is controlled by changes in the distribution system pressure. The pumps are arranged for sequential operation. Under normal conditions, the jockey pump operates to maintain the designed system static pressure. Should there be a demand for fire water which exceeds the capacity of the jockey pump, system pressure will drop and the electric fire pump will start. If system pressure continues to drop, the diesel pump will start.

The yard distribution system consists of a compound loop arrangement serving all areas of the site. The system supplies fire water to all facilities containing a sprinkler system. In addition, the system supplies fire hydrants, which are located at approximately 300 ft (91 m) intervals throughout the site. The system contains numerous sectionalizing and control valves, which are locked, sealed, and visually checked monthly.

All major components of the Fire Water Supply and Distribution System are UL- listed and FM-approved.

4.5.1.1.2 Fire Suppression System/Fire Detection and Alarm System

The fire suppression system consists of several different fire extinguishing systems or equipment that service the surface buildings and facilities and for the underground areas. These may include any one or more of the following fire extinguishing capabilities: automatic wet pipe sprinkler system, standpipe and hose reels, automatic dry chemical extinguishing system, and portable fire extinguishers. The automatic wet pipe sprinkler system is the primary suppression system for fire protection at the WIPP. The fire detection and alarm system consists of multiple systems, each utilizing most or all of the following components: heat sensing fire detectors, smoke detectors, sprinkler system water flow alarm devices, manual fire alarm systems, control panels, audible warning devices, and visual warning devices. A complete description of the type of fire suppression system provided at each WIPP surface structure and the underground is provided in the *WIPP Fire Hazard Analysis*.[2]

4.5.1.1.3 Radio Fire Alarm Reporter System

The radio fire alarm reporter (RFAR) system provides notification of fire alarm and trouble signals to the CMR for structures not connected to the CMS local processing units and for structures which could have significant program or monetary impact. This system consists of radio transmitters that relay alarm and trouble signals via an FM signal to a central base station/receiver. The signal is displayed in the CMR.

4.5.1.1.4 Fire Protection System Design, Installation, Testing and Maintenance

The following NFPA[4] standards apply at the WIPP facility:

- The fire water supply and distribution system (pumps and hydrants) are designed, installed, tested, and maintained according to NFPA[4] 20, NFPA[4] 24, and NFPA[4] 25.
- The automatic wet pipe sprinkler systems are designed, installed, tested, and maintained in accordance with NFPA[4]13 and NFPA[4]25.
- The dry chemical fire suppression systems are designed, installed, tested and maintained in accordance with NFPA[4] 17.
- The fire detection and alarm systems are designed, installed, tested, and maintained in accordance with NFPA[4] 72.
- The radio fire alarm reporter system is designed, installed, tested, and maintained in accordance with NFPA[4] 72 and NFPA[4] 1221.

4.5.2 Plant Monitoring and Communications

The plant monitoring and communications systems include on-site and plant to off-site coverage. The systems are designed to provide immediate instructions to facility personnel to assure personnel and WIPP facility safety, WIPP facility security, and efficient WIPP facility operations under normal and emergency conditions.

Plant Monitoring and Communications includes the following systems:

- Central monitoring system
- Plant communications
    - Touch tone phones
    - Mine pager phones
    - Plant PA (including the Site Notification System) and alarm systems
    - Radio
    - CMS VAX Computer

4.5.2.1 Central Monitoring System

The CMR is the central location for the collection and monitoring of real time site data, automatically and manually, during normal and emergency conditions. The CMR was not intended to be designed or operated in a manner similar to the control room of a nuclear power plant. Most of the underground and surface data monitored in the CMR is gathered, processed, stored, logged, and displayed by the CMS, which collects the data continuously from approximately 1,500 remote sensors.

The CMS is a Design Class IIIA, computer-based monitoring and control system. It is used for real-time site data acquisition, display, storage, alarm and logging and for the control of site components. The CMS monitors the following systems:

- Radiation monitoring, with input from selected area radiation monitoring system (ARMS) detectors, selected continuous air monitoring systems (CAMS), radiation effluent monitoring systems (REMS).
- Electrical power status, including back-up diesel operation.
- Fire alarm system, including system status parameters.
- Ventilation system, including damper position, fan status, flow measurement, and filter differential pressure.
- Meteorological data, including wind speed and direction, temperature, and barometric pressure.
- Facility systems, including air compressors, vacuum pumps, and storage tank levels.

The CMR has three operator stations, including an engineer's station, which display alarms, status, trends, graphics, and interactive operations. The CMS electronic data storage devices are located in the computer room adjacent to the CMR. Operator's stations and an engineer's station are located in the CMR, and the backup operator's stations are located in the security control room, computer room, and underground operations connex (S-550).

The CMR has special features to allow its use during both normal and emergency conditions. These features include two-hour fire walls and redundant ventilation systems, including HEPA filtration of intake air to allow occupancy during radiological releases. The CMR sources of back-up AC electrical power include an uninterruptible power supply (UPS), with a minimum life expectancy of 30 minutes, and the diesel generator used to power priority loads (including the CMR) as discussed in Section 4.6.

4.5.2.2 Plant Communications

The dial phone system includes a private automatic branch exchange (PABX) network providing conventional on-site and off-site telephone services. Major uses of this subsystem include the reporting of occurrences (DOE Order 5000.3B)[5] and communications between the CMR and the following:

- Roving operators and instrumentation technicians.
- The Emergency Operations Center (EOC).
- Various departments such as Health Physics, Transportation, and Security.

The mine pager phones make up an independent, hard wired, battery-operated system for two-way communications between the surface and underground operations.

The plant public address (PA) and alarm systems provide for the initiation of surface and underground evacuation alarms and public address announcements from the CMR and local stations. The plant PA and alarm systems includes the site-wide PA and intercom installations, the Site Notification System for remote locations, and an additional underground evacuation alarm system. These alarms are supplied with backup power if the off-site power supply fails. The PA system master control console is located in the CMR, with paging stations located in the support building, waste handling building, water pumphouse, guard and security building, salt handling hoist house and head frame, exhaust filter building, safety and emergency services facility, engineering building, warehouse/shops building, and underground.

Radio includes two-way and paging on-site and off-site radio systems. These systems include base stations in the CMR, security control room, emergency operations center, and mobile and portable units.

4.5.2.3 Radiation Monitoring System

The Radiation Monitoring System includes five basic subsytems to ensure adequate information on plant radiation for protection of plant personnel and the surrounding environment under normal operation, off-normal events, and recovery from off-normal events. The subsystems are: Continuous Air Monitoring (CAM) System, Fixed Air Sampling (FAS) Systems, Area Radiation Monitoring (ARM) Systems, Radioactive Effluent Air Monitoring (REMS) Systems, and the Plant Vacuum (PV).

The five subsystems are coordinated into a single design package. Signals are provided to the CMR to provide continuous surveillance and display or log alarm status on the CRT or printer for selected CAM, REMS and ARM stationary monitors. Status of the PV system is also available at the CMR.

References for Section 4.5

1. DOE Order 5480.7A, Fire Protection, February 17, 1993.

2. WIPP-WID-96-2176, Rev. 1, *WIPP Fire Hazard Analysis Report*.

3. WP 12-9, WIPP Emergency Management Program, Rev. 11.

4. National Fire Protection Association.

5. DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information, February 22, 1993.

4.6 Utility and Auxiliary Systems

4.6.1 Electrical System

Unless otherwise indicated, all electrical system components are Design Class IIIB. The electrical system is designed to provide: normal and backup power to WIPP electrical equipment, grounding for electrically energized equipment and other plant structures, lightning protection for the plant, illumination for the plant surface facility, and for related underground operations.

Standard industrial electrical distribution equipment is used throughout. Equipment used includes medium voltage switchgear buses, medium voltage to low voltage step-down unit substations, motor control centers, small distribution transformers and panels, relay and protection circuitry, station batteries along with associated synchronous inverters, diesel generator sets, and the cabling, enclosures, and other structures required to locate and interconnect these items.

The electrical system is designed to supply power at the following nominal bus voltages:

- 13.8 kVac, nominal, 3-phase, 3-wire, 60-Hz - Power supply for the main plant substation, underground switching stations, and surface and underground unit substation transformers.
- 4.16 kVac, nominal, 3-phase, 3-wire, 60 Hz - Power supply for the main exhaust fan drive motors.
- 2.4 kVac, nominal, 3-phase, 3-wire, 60 Hz - Power supply for the drive motor for the M-G set, which provides the backup supply for the Salt Handling Shaft Drive Motor.
- 480/277 Vac, nominal, 3-phase, 4-wire, 60 Hz - Power supply for motor control centers, the AIS drive motor, solid state direct current converter systems for the SH and waste hoists, underground filtration fans, lighting and power distribution transformers.
- 120/208 Vac, nominal, 3-phase, 4-wire, 60 Hz - Power supply for control systems, instrumentation, lighting, communication, and small (fractional horsepower) motor-driven equipment.
- 120/208 Vac, nominal, 3-phase, 4 wire, 60 Hz - Uninterruptible power supply (UPS) for control and instrumentation which must be continuously energized under all plant operating modes.

4.6.1.1 Major Components and Operating Characteristics

There are three sources of power at the WIPP facility: normal power, backup power, and UPS.

4.6.1.1.1 Normal Power Source

The WIPP facility normal power is supplied by a public utility company, and is the preferred power source supplying power to the WIPP facility at all times.

The electrical utility company supplies electrical power from their 115 kV Potash /Kerrmac Junction open wire transmission line from the North and Whitten/Jal Substation open wire line from the South. The North line is about 9 miles long while the South line is about 19 miles long. The Potash Junction and Whitten Substations each have two feeders from multiple generating stations and loss of one generating source does not interrupt power to the WIPP facility.

The Utility substation at the WIPP facility is located East of the Property Protection Area. Area substations are located at the various surface facilities. Underground conduits, cable duct banks, and buried cables connect the Plant substation with the area substations.

4.6.1.1.2 Backup Power Source

In case of a loss of utility power, backup power to selected loads can be supplied by either of the two on-site Design Class IIIA 1,100 kW diesel generators. These generators provide reliable 480-V power, and are sized to feed the loads listed in Table 4.6-1. Backup power is fed through buses A and B (Figure 4.6-1). Each of the diesel generators can carry all preselected monitoring loads (see Section 4.6.1.1.3 for a discussion of essential loads) plus operation of the AIS hoist for personnel evacuation, and other selected backup loads in accordance with procedures in the WIPP WP 04-ED Facility Operations Procedures.[1]

Upon loss of normal power, the diesel(s) is started manually by the facility operator within 30 minutes using the electric starter/batteries. Only one diesel may be loaded at a time.[2] The starter system is a 24 V battery system with a 300 amp-hour capacity. The diesel generators may be started from the local control panel or from the CMR. Monitoring of the diesel generators and associated breakers is possible at the CMR, thus providing the ability to feed selected facility loads from the backup power source, in sequence, without exceeding generator capacity. The on-site total fuel storage capacity is sufficient for the operation of one engine generator at full load for one day, and additional fuel supplies are readily available within a few hours by tank truck allowing on-line refueling and continued operation.

The diesel generators and the generator load center are located outside between the Safety and Emergency Services Building and Exhaust Filter Building. A 480-V backup power indoor switchgear is located in the main electrical room in the Support Building. Area substations are located at various surface facilities.

Operation of backup power supplies and the selection of loads is addressed in the WIPP WP 04-ED Facility Operations Procedures.[1]

4.6.1.1.3 Uninterruptible Power Supply (Essential Loads)

The central UPS provides power to essential equipment (Table 4.6-2) located in the Support Building and the Waste Handling Building. The central UPS is located in the Support Building. In addition, individual UPSs provide transient-free power to strategically located LPUs for the radiation monitoring system on the surface, in selected areas in the exhaust shaft, and underground passages and waste disposal areas.

The purpose of the central UPS is to supply (120/208 Vac, 222 A) transient-free, reliable power to the essential loads listed in Table 4.6-2. This ensures continuous power to the radiation detection system for airborne contamination, LPUs, computer room, central monitoring room, and primary analytical chemistry laboratory instruments, even during the interval between the loss of off-site power and initiation of backup diesel generator power.

In case of loss of AC power input to the UPSs, the dedicated batteries can supply power to a fully loaded UPS for 30 minutes. The AC power input to the UPS will be restored within approximately 30 minutes via operator action.

All monitoring loads fed from the UPS system are shown on Westinghouse Drawing panel schedules for 41P-DP03/10, 41P-DP03/11, 45P-DP03/15, and 41P-DP03/17.[3] The connected load, as measured, is shown in Table 4.6-2.

4.6.1.1.4 Safety Considerations and Controls

Failure of the normal distribution system or any of its components will not affect safe conditions of the WIPP facilities. Upon loss of normal off-site power, the Exhaust Filter Building isolation valves fail to the filtration mode. The simplified single-line diagram for the normal and manually switched backup loads is shown in Figure 4.6-2a and Figure 4.6-2b (switching devices and equipment are symbolically represented).

4.6.2 Compressed Air

The compressed air system is Design Class IIIB except for the HEPA inlet filters for the backup compressors in the Support Building, which are Design Class II. The system is diverse in the types and sizes of compressors used, and redundancy is provided for the main plant air compressors, exhaust filter building, support building, salt hoist house, and the underground. All are electrically driven except for the diesel powered backup compressor in the underground.

The piping system consists of runs of 2, 4, and 6 in (5, 10, and 15 cm) pipe connecting the two compressor buildings to the waste handling building, support building, exhaust filter building, salt hoist house, and safety building. A pipe run down the waste shaft serves the underground. Each building and the underground can be isolated from the system.

There are two general types of compressors in use at the WIPP. The majority are reciprocating, but the primary main plant air compressors and the underground backup compressor are rotary screw type. All are either single- or two-stage units; the backup main plant air compressors and the backup units at the support building are the non-lubricated type for oil free output air.

The primary main plant air compressors are two single stage rotary screw units of 250 horsepower with a maximum capacity for each unit of 1,155 cfm (0.55 m^3/s) at a system pressure of 125 psi (8.8 kg/cm^2). Cooling for these compressors is accomplished with a fin and tube heat exchanger and cooling fan placed in the lubricating oil system.

The secondary main plant air compressors are two, two-stage, double acting reciprocating units of 200 horsepower and maximum capacity of 1,000 cfm (0.4 m^3/s) at 125 psi (8.8 kg/cm^2). These compressors are the only water cooled units on site, using a closed loop system, pumping a mixture of water and ethylene glycol antifreeze through a fin and tube heat exchanger with four electrically driven cooling fans.

A twin tower desiccant air dryer with prefilters and after filters is located just downstream of the compressors at each of the above installations to provide clean, moisture-free, compressed air dried to a dew point of 0 degrees F (-18 degrees C). A 1,000 gallon (3785 L) capacity air receiver is located just downstream of the dryer at each location and connected to the site piping system.

The backup compressors at the support building are aligned in parallel with the incoming plant air line. In the event of a loss of plant air, a check valve isolates the building from the plant air system, and the backup compressors start automatically as the building pressure drops to 100 psi.

The backup compressors at the support building utilize HEPA filters for their inlet air rather than the less efficient type found on the other units. In the event of a high radiation alarm from Station C, the HVAC system supplying the CMR is automatically shifted to a HEPA filtered supply air. At the same time, a signal is sent to close a solenoid valve isolating the building from the plant air system. The HVAC dampers and controls will now be operated by HEPA filtered air provided by the backup compressors to preclude contamination of the CMR air supply.

The support building, waste handling building, and exhaust filter building employ desiccant air dryers similar to the large units installed at the main compressor buildings but much smaller. These dryers provide additional filtering of the air and lower the dew point to -40 degrees F (-40 degrees C). The Plant Air System ends at these dryers and the Instrument Air System begins. Instrument quality air is then used to operate dampers and control systems for the underground ventilation system and HVAC systems in the above mentioned buildings.

The salt hoist house has a backup installation similar to those described above but using a refrigerated air dryer instead of the desiccant type. This unit provides air for operation of the hoist brakes in the event of a loss of plant air.

The maintenance shop, AIS hoist house, warehouse, and engineering building each have a stand alone compressor installation for vehicle maintenance, hoist operation, HVAC system operation, and other utility purposes. These buildings are not supplied by the plant air system.

Compressed gases sub-systems are installed in three site locations. The dosimetry laboratory uses nitrogen in processing the thermo-luminescent detectors. The counting laboratories use P-10, hydrogen, and liquid nitrogen in various analytical procedures. Mine Rescue uses high-pressure oxygen to refill breathing pack bottles. The commercial gas bottles are installed with safety binding and supply manifolds. Rescue uses compressed air for Scott Air Packs.

Inlet Air Filters (45-K-100A and B)

The compressed air supplied to the CMR in the Support Building must be free of radioactive particulates, and since these compressors only operate when the plant air supply fails or when radiation has been detected, HEPA filters are used as the inlet filters for these compressors. One HEPA filter supplies two compressors -- one compressor on each receiver; a second filter supplies the other two compressors. These filters preclude the entry of airborne radioactive particulates into the compressed air stream.

4.6.3 Water Distribution System

The Water Distribution System is designed to receive water from a commercial water department, transport the water to the WIPP Site, provide storage for the required reserve of fire water, chlorinate and store domestic water, and distribute domestic water for use by personnel, processes, HVAC and irrigation.

4.6.4 Sewage Treatment System

The sewage treatment facility collects and treats sanitary waste and nonradioactive liquids from the surface. Provisions also exist for the facility to receive non-hazardous effluents typically resulting from observation wells and the de-watering of mine shafts.

References for Section 4.6

1. WP 04-ED, WIPP series Facility Operations Procedures.

2. Air Quality Permit No. 310-M-2.

3. Main UPS System Panel Schedules 41P-DP03/10, 41P-DP03/11, 45P-DP03/15, 45P-DP03/17.

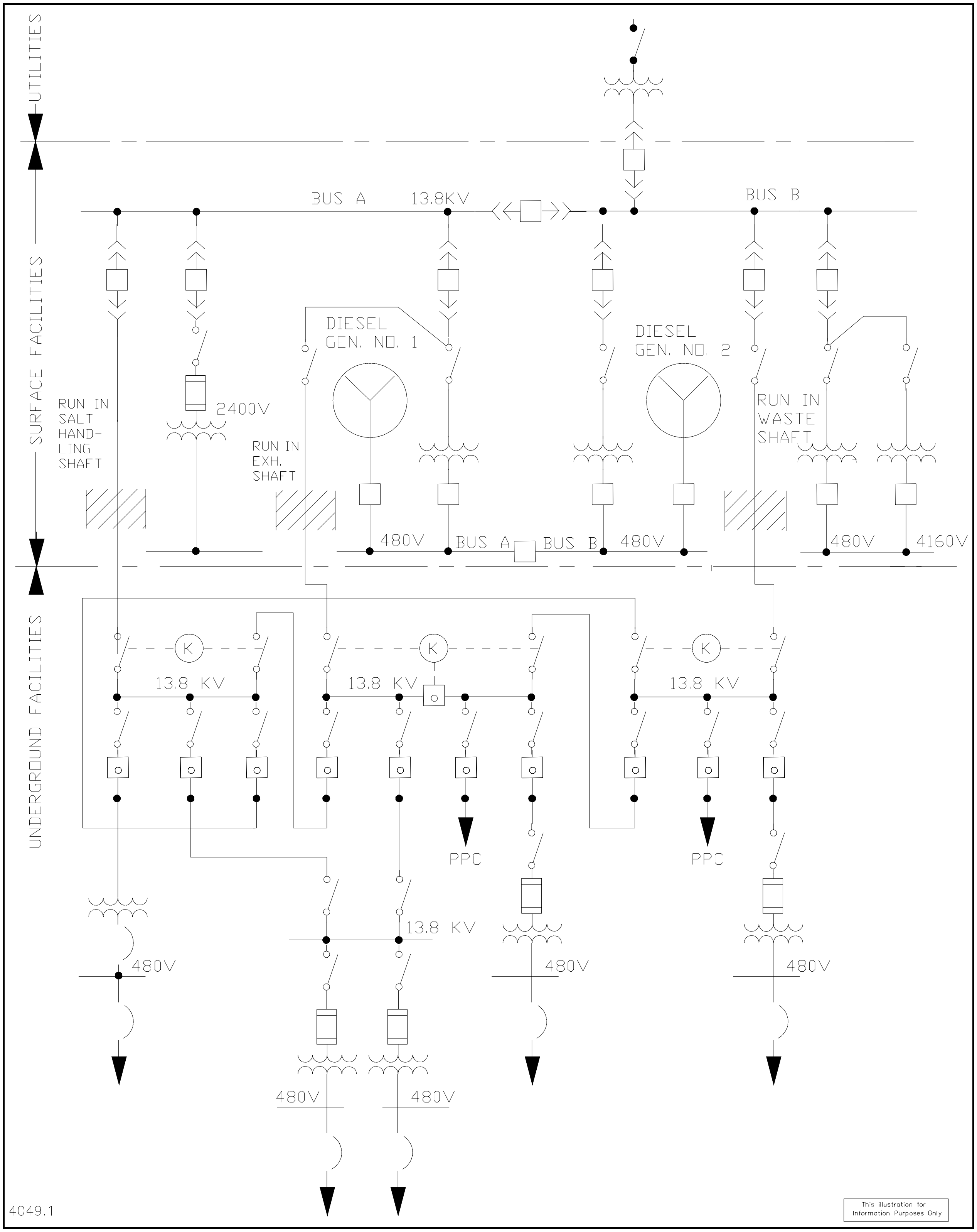

Figure 4.6-1, Electrical Distribution System

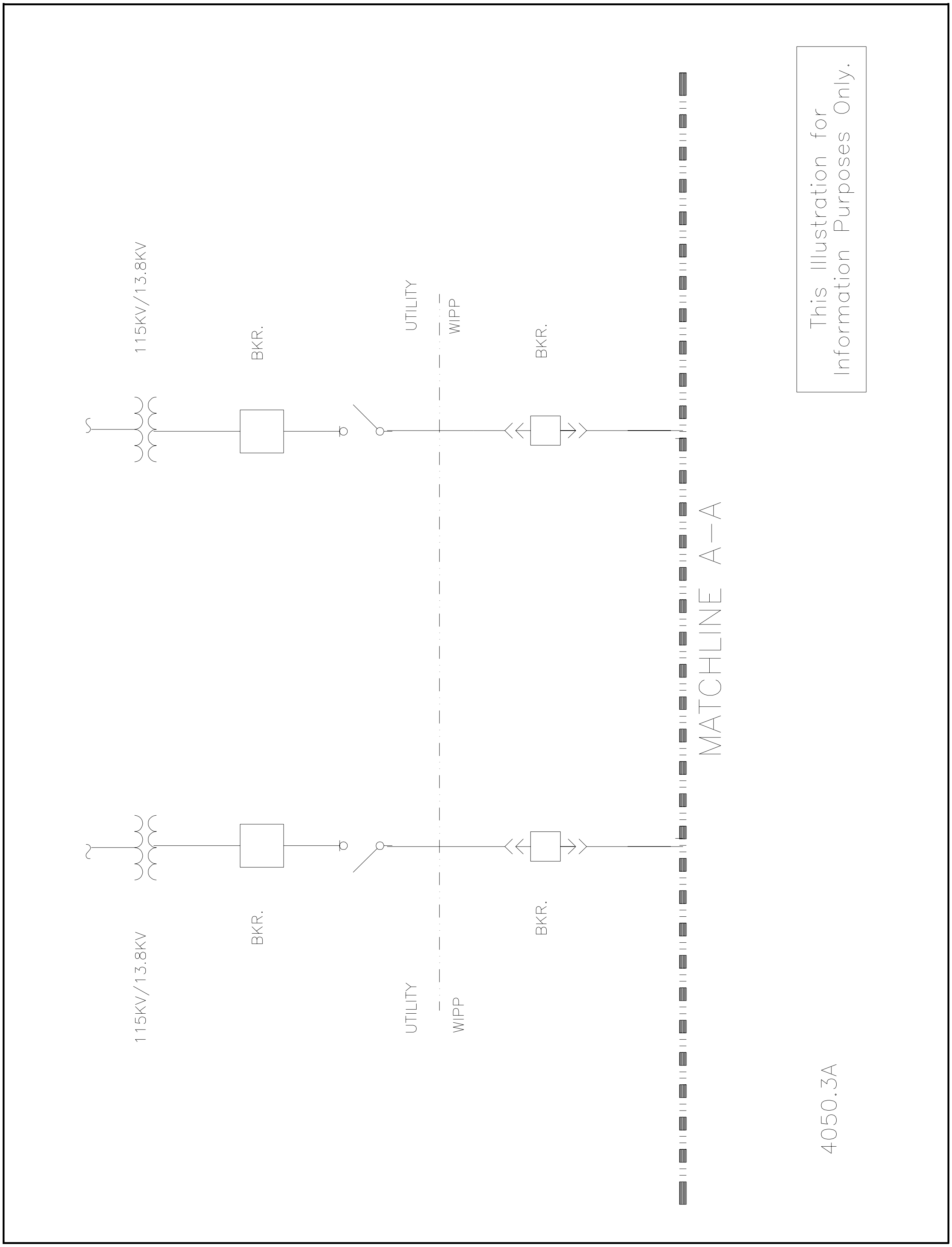

Figure 4.6-2a, 13.8 kV Power Distribution System Single Line Diagram

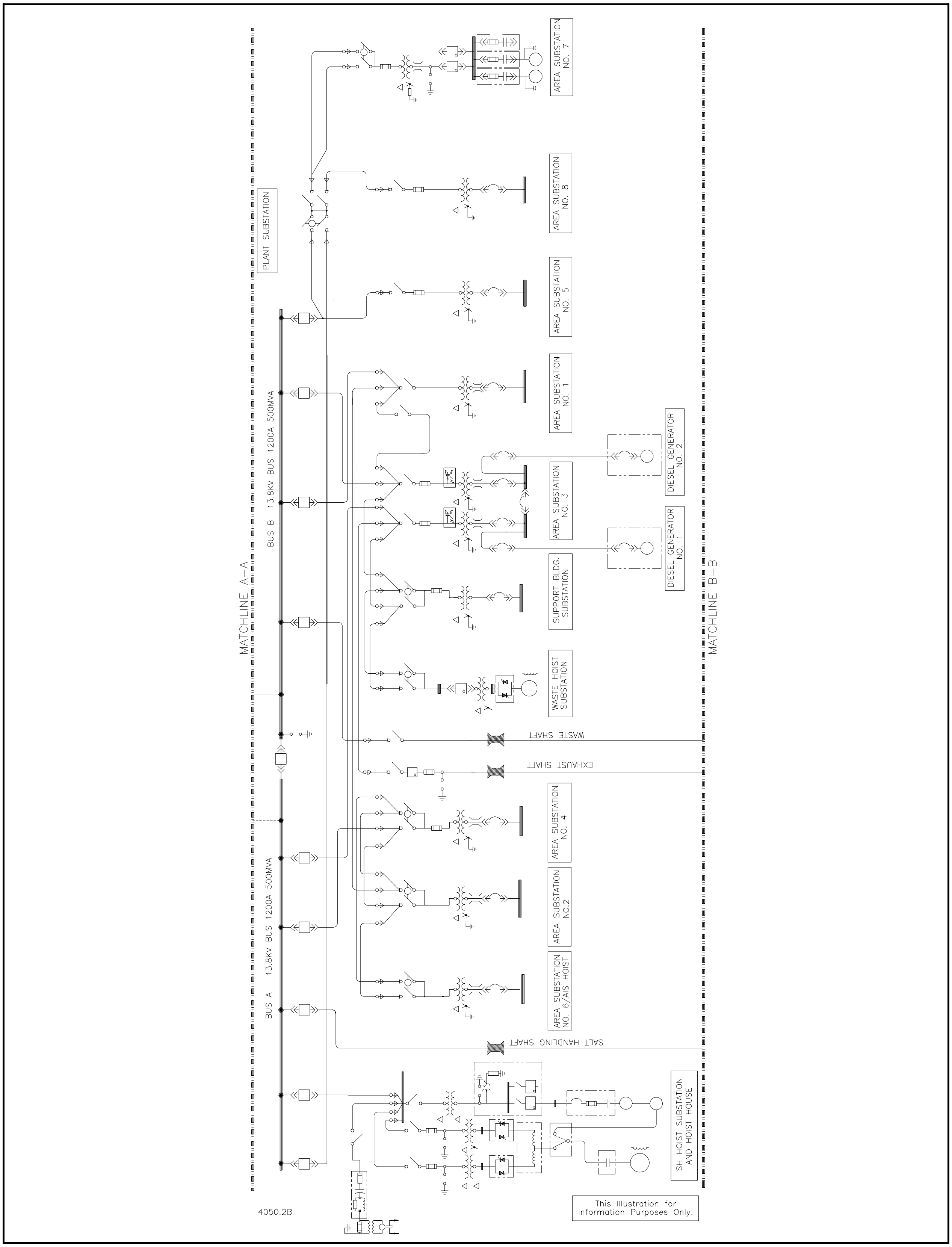

Figure 4.6-2b, 13.8 kV Power Distribution System Single Line Diagram

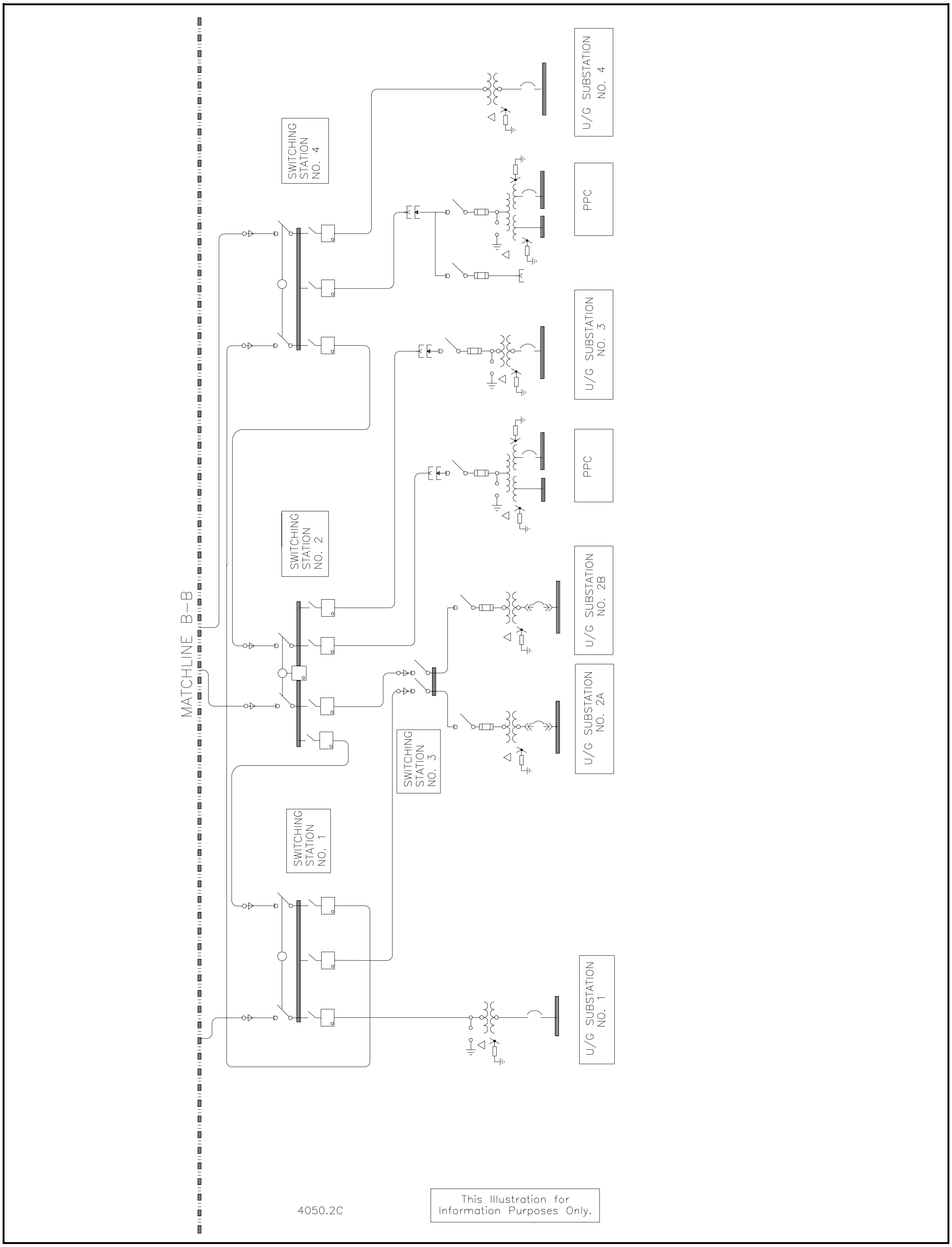

Figure 4.6-2c, 13.8 kV Power Distribution System Single Line Diagram

Table 4.6-1, Diesel Generator Load

Manually Switched Backup		
Loads	**kW**	**Remarks**
Uninterruptible Power System* Central Monitoring System* WHB Continuous Air Monitors*	72	
Central Monitoring Room HVAC System Utilities	20	
Fire Protection Systems in the Waste Handling Building Support Building	30	Battery power is provided in fire protection system until the diesel generator is started and loaded.
Fire Pump	160	
Communications Systems	16	
Guard & Security Building	35	
Air Intake Shaft Hoist (If necessary for U/G evacuation)*	330	The diesel generators load is reduced to 900 kW prior to operating the AIS hoist.
WHB Lighting	45	
WHB Cranes	80	After the diesel generator is started cranes are energized as required to land their loads.
WHB Vacuum Pumps	50	
Main Air Compressors (1-200 hp)*	160	
U/G Exhaust Fans (1-235 hp)*	188	
Waste Handling Building Fans*	100	
U/G Sandia other Experimental Loads	400	
Safety & Emergency Services Building (EOC)*	10	
* Priority Back-up loads. Other loads picked up depending on actual kW loading of diesel or by load shedding.		

Table 4.6-2, UPS Loads

LOAD ON CENTRAL UPS	
• Radiological Monitoring System (ARM & CAM), • Central Monitoring System - CMS equipment in the Support Bldg. and in Waste Handling Bldg, • Communication System in Waste Handling and Support Bldg, • Seismic Trip in Waste Handling Bldg. • Network computers and equipment in the Support Bldg. Computer Room. Total Connected Load Running Load	88 kW 30 kW
Loads on Individual UPS Units	
• CMS equipment in facilities other than Waste Handling and Support Buildings. • Selected Surface and Underground Radiological Monitoring Units, • Emergency Operations Center and Safety and Emergency Services Facility Guard and Security Building, • Safety Communication and Alarm System in facilities other then Waste Handling and Support Buildings. Total Independent Backup System Load	66 kVA

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4.7 Radioactive Waste (Radwaste) and Hazardous Waste Management

Since the WIPP facility operational philosophy is to remain radiologically clean, decontamination operations following detection of contamination may generate some radioactive waste. The plant-derived waste could originate in both the surface and underground facilities. Because derived wastes can contain only those materials present in the waste from which they were derived, no additional characterization of the derived waste is proposed for disposal purposes. Characterization of derived waste will primarily be based on process knowledge. High activity waste is not expected to be generated during any normal operating sequences.

4.7.1 Liquid Radwaste System

Water used as a fire suppressant is the largest potential source of liquid radwaste. Another source would be any liquid used for decontamination. The fire potential in waste handling areas is remote, and contaminated water from fire fighting is not expected. All suspect liquids are collected, sampled and analyzed for radioactivity, and if the liquid exceeds the uncontrolled release limit of Order DOE 5400.5,[1] it is collected and made acceptable for disposal in the WIPP.

All non-fire water liquid radwaste is collected in portable tanks or drums, and handled in accordance with procedures in the WP 05-WH1036, Site-Derived Mixed Waste Handling,[2] and the RCRA Compliance Manual.[3]

4.7.2 Solid Radwaste System

The solid radwaste system provides for the collection and packaging of site-derived solid radwaste. It is anticipated that all site-derived waste will be contact handled, due to its low activity and the nature of the potential for sources of site-derived solid waste at the WIPP facility.

The maximum estimated solid radwaste volumes derived at the WIPP facility are listed below.

Source	Estimated Annual Volume cubic feet	(cubic meters)
Health Physics Laboratory	4	(0.11)
Solid Waste	205	(5.81)
Decontamination efforts	200	(5.66)
Sweeping	8	(0.23)
TOTAL	417	(11.8)

These maximum solid radwaste volumes are extremely conservative and actual volumes are expected to be much less. Solid radwaste is collected in standard Type A containers with filter vents, and accounted for in the WWIS.

4.7.3 Hazardous Waste System

Nonradioactive hazardous waste generated on-site typically includes absorbed liquids from spills and routine usage of maintenance products, including oils, coolants, and solvents. Safe storage of these materials and associated hazards are administered by the Site Generated Non-Radioactive Hazardous Waste Management,[4] and the Industrial Safety Program,[5] and the WIPP Emergency Management Program.[6]

A Hazardous Waste/Material Storage Facility is provided for storage of various types of incoming and outgoing hazardous materials prior to shipment to a Treatment Storage and Disposal Facility, and is shown in Figure 4.1-2a.

References for Section 4.7

1. DOE Order 5400.5, Radiation Protection of the Public and the Environment, January 7, 1993.

2. WP 05-WH1036, Site-Generated Mixed Waste Handling.

3. WP 02-RC.03, Resource Conservation and Recovery Act (RCRA) Compliance Manual.

4. WP 02-RC.01, Site Generated Non-Radioactive Hazardous Waste Management.

5. WP 12-IS.01, Industrial Safety Program.

6. WP 12-9, WIPP Emergency Management Program.

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4.8 Human Factors Engineering Considerations

This section summarizes the systematic inquiry of the importance to safety of reliable, correct, and effective human-machine interactions, considering the mission of the WIPP facility and the physical nature of the radioactive wastes that it will receive. The specific human errors that can contribute to accidental releases of hazardous materials are discussed in Chapter 5 as an integral part of each hypothesized accident. Based on the analysis of those accidents and the discussion below, it can be concluded that the WIPP waste acceptance criteria for transuranic wastes, facility design, and operational controls provide high confidence that all potential releases can be contained with passive safety features that eliminate the need for human actions requiring sophisticated human-machine interfaces.

To provide additional support for the conclusion that no detailed human factor evaluation of human-machine interfaces is required, a scoping assessment of the effectiveness of the human-machine interfaces that support important design functions of the Table 4.1-1 Design Class II and IIIA systems is summarized in Table 4.8-1. [It can be seen that most of the Design Class II and IIIA WIPP systems and equipment do not require human actions to initiate or sustain their function relative to the release of radiological or nonradiological waste materials.] In most cases these functions are accomplished with automatic passive mechanisms designed to provide containment for the waste materials.

Functions allocated to automatic passive mechanisms or automatic active systems may be influenced by human error during maintenance. However, using the graded approach, human-machine interfaces for maintenance activities at WIPP are judged to be adequate because they are deliberate, and there is ample opportunity to discover errors and correct them with no adverse safety consequences. The policy outlined in WP 10-2, Maintenance Operations Instruction Manual,[1] states that maintenance shall have a high degree of integration with other activities and shall have minimal impact on operations. Maintenance on specific systems is listed on the Plan of the Week, which Operations management must approve. A Plan of the Day meeting further ensures that coordination will be maintained. Finally, the facility is designed to provide adequate space and a favorable environment in which to accomplish maintenance activities.

The ability of the staff to accomplish their responsibilities in potential accident environments is addressed in Section 8.5. As discussed in the justification for the graded approach below, the limited magnitude of the hazard and the lack of dispersal driving forces provide very high confidence that the staffing and training presented in those sections will enable the staff to perform their responsibilities in potential accident environments.

The above graded approach to human factors engineering considerations is justified by the evaluation of the design and operation of the WIPP against three criteria given in Paragraph 8a of DOE Order 5480.23:[2]

- **Criteria (a) — Magnitude of Hazard.** The magnitude of hazardous materials that can be involved in an accident leading to a release is very limited. The radioactive material is delivered to the site in sealed containers; and, the waste handling operations are designed to maintain that integrity throughout the entire process required to safely emplace those containers in the site's underground waste disposal rooms. Inventory limits on individual containers ensure that heat generated by radioactive decay can be easily dissipated by passive mechanisms. Finally, only a limited number of waste containers have the possibility of being breached as a result of any one accident initiating event. As a result, the consequences of unmitigated releases from all accidents hypothesized in Chapter 5, including those initiated by human error, do not produce significant offsite health consequences.

- **Criteria (b) — Complexity of the Facility and/or Systems Being Relied on to Maintain an Acceptable Level of Risk.** The facility has no complex system requirements to maintain an acceptable level of risk. The facility is designed to minimize the presence and impact of other energy sources that could provide the heat or driving force to disperse hazardous materials. When something unusual happens during normal operations, such as support systems becoming unavailable, **waste handling can be simply stopped and personnel evacuated until an acceptable operating condition is reestablished**.

  Should an initiating event occur that breaches the waste containers, **the plant design permits the immediate cessation of activity and isolation of the area where the breach occurs**. Once isolation is achieved, there is no driving force within the waste or waste handling area that could result in a release of the waste material. Consequently, sufficient time is available to thoroughly plan and prepare for the remediation process prior to initiating decontamination and recovery actions.

- **Criteria (c) — Stage of Life Cycle.** Human factors considered here is limited to that time necessary to properly emplace the transuranic waste designated for disposal at WIPP. The operations will be straightforward, proceduralized, and consistent. Moreover, operations will be continued for only the period of time needed to complete the disposal process.

  Once a panel is filled and sealed off, the natural properties of the salt and the location of the mine combine to provide passive isolation of the waste from the environment. The potential for human intrusion after the facility closure is beyond the scope of the human factors evaluation considered here.

References for Section 4.8

1. WP 10-2, Maintenance Operations Instruction Manual.

2. DOE Order 5480.23, Nuclear Safety Analysis Report, 8-10-94.

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 1 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	**Design Class**	**Design Class Function**			
COMPRESSED AIR SYSTEM (SDD-CAOO)					
High Efficiency Particulate Air (HEPA) filters for Support Building compressors	II	Control of radioactive effluent from entering the compressed air system	Passive Mechanisms	None	Adequate
PLANT BUILDINGS, FACILITIES, AND MISCELLANEOUS EQUIPMENT (SDD-CFOO)					
Waste Handling Building structure and structural components including tornado doors (Bldg. 411)	II	Provide physical confinement	Passive Mechanisms	None	Adequate
Station A Effluent Monitoring Instrument Shed (Bldg 364)	II	Design Class Interface. (Houses Station A)	Passive Mechanisms	None	Adequate
Effluent Monitoring Rooms A and B (Building 413A and 413B)	II	Design Class Interface. (Houses Local Processing Units (LPU)s collecting data from Stations A and B)	Passive Mechanisms	None	Adequate
Station B Effluent Monitoring Instrument Shed (Bldg 365)	IIIA	Design Class Interface. (Houses monitoring equipment for Exhaust Filter Building duct)	Passive Mechanisms	None	Adequate
Support Building (Bldg 451)	IIIA	Design Class Interface. (Houses Central Monitoring Room (CMR))	Passive Mechanisms	None	Adequate
Exhaust Filter Building (Bldg 413)	IIIA	Design Class Interface. (Houses Exhaust Filtration System)	Passive Mechanisms	None	Adequate
EFB HEPA Filter Units & Isolation Dampers	II	Failure could prevent mitigation	Passive Mechanisms	None	Adequate

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	**Design Class**	**Design Class Function**			
EFB Exhaust System	IIIA	Failure could prevent mitigation	Passive Mechanisms	None	Adequate
Building 412 (Originally TRUPACT Maintenance Facility)	IIIA	Design Class Interface. (Structural interface with WHB)	Passive Mechanisms	None	Adequate
PLANT MONITORING AND COMMUNICATION SYSTEM (SDD-CMOO)					
Central Monitoring System	IIIA	Monitors important facility parameters	Automatic with alarms and readout in CMR.	CMRO fails to monitor and back up automatic functions. No human mitigation of ongoing scenario	Adequate
ELECTRICAL SYSTEM (SDD-EDOO {Surface and Underground})					
Diesel Generator and associated equipment	IIIA	Provides backup power to Design Class II and IIIA items	Active - Manual startup and loading, either locally or from the CMR, within 30 minutes to prevent loss of UPS.	None. Loss of active ventilation allows only very minor leakage of airborne radioactive materials loss of ΔP. 30 minutes is sufficient time for suspension of underground activities and evacuation of personnel to surface to comply with mine safety requirements.	Adequate
ENVIRONMENTAL MONITORING SYSTEM (SDD-EM00)					
Volatile Organic Compound (VOC) Monitoring Equipment and sub-systems	IIIA	Monitors release of VOCs	N/A	No safety function - Periodic sampling for confirmatory monitoring in accordance with RCRA	Adequate
HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEM (SDD-HV00)					

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 3 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	Design Class	Design Class Function			
Exhaust Filtration System	II	Design Class Interface. (Control of radioactive effluent)	Passive mechanisms.	None. Filters required to be online during waste handling.	Adequate
HEPA Filters	II	Control of radioactive effluent	Passive Mechanisms	None. Filters required to be online during waste handling.	Adequate
Tornado Dampers	II	Control of radioactive effluent	Automatic	None	Adequate
Exhaust Systems HV01 (Bldg 411, CH HVAC), HV02, (Bldg 411, RH HVAC), and HV04 (Station A and Bldg 413, Exhaust Filter Building HVAC)	IIIA	Design Class Interface. (Provide filtration and maintain differential pressure)	Passive Mechanisms	None. Systems required to be online during waste handling.	Adequate
HVAC for the CMR	IIIA	Design Class Interface. (Maintains acceptable CMR environment)	Automatic	None	Adequate
RADIATION MONITORING SYSTEM (SDD-RM00)					
Stations A3, B2, and C (including UPSs)	II	Monitors radioactive effluents	Automatic with alarms and readout in CMR.	CMRO fails to verify operation and notify plant personnel. FSM fails to initiate facility emergency plans. No human mitigation of ongoing scenario.	Adequate
The remainder of the RMS SSCs (except PV00 equipment which is IIIB) are Design Class IIIA	IIIA	Monitors radioactive effluents	Automatic with alarms and readout in CMR.	CMRO fails to verify operation and notify plant personnel. FSM fails to initiate facility emergency plans. No human mitigation of ongoing scenario.	Adequate
UNDERGROUND HOIST SYSTEM (SDD-UH00)					
Waste Hoist and Equipment	IIIA	Failure could cause radioactive material release	Automatic (See WIPP/WID-96-2178 Rev. 0)	None	Adequate

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 4 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	**Design Class**	**Design Class Function**			
UNDERGROUND VENTILATION SYSTEM (SDD-VU00)					
Exhaust duct elbow at the top of the Exhaust Shaft	II	Design Class Interface. (Channels exhaust air to the EFB)	Passive Mechanisms	None	Adequate
HEPA Filters and Isolation Dampers	II	Control of radioactive effluent	Passive Mechanisms	None	Adequate
Exhaust Fans for the filtration mode	II	Design Class Interface. (Channels exhaust air through the EFB)	Passive Mechanisms	None	Adequate
Exhaust System Instruments and Hardware	IIIA	Design Class Interface. (Supports Exhaust Filtration System)	Passive Mechanisms	None	Adequate
(6) High Pressure Fans for Bulkhead 309 (Pressure Chamber)	IIIA	Maintain buffer zone between RMA and non-RMA	Passive Mechanisms	None	Adequate
WASTE HANDLING EQUIPMENT (SDD-WH00)					
6-ton TRUDOCK cranes	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
Adjustable Center-of-Gravity Lift Fixtures (ACGLF's)	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
TRUPACT-II tools	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
Leak check tools for TRUPACT-II	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 5 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	Design Class	Design Class Function			
TRUPACT-II Lift Fixture (Non ACGLF)	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
Strongback Lifting Fixture (CH)	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
SWB Lift Fixture Adapter	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
TDOP Lift Fixture Adaptor	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
SWB Forklift Lift Fixture	IIIA	Failure could cause radioactive materials release	Active - Manual in use	Failure could lead to initiating event for CH Accident Release	See SAR CH 5
TRUDOCK Vent Hood System	IIIA	Failure could prevent mitigation	Active - Manual in use	Failure could lead to loss of mitigation	See SAR CH 5
Facility Cask	II	Provides permanent shielding	Passive Mechanisms	None	Adequate
Telescoping Port Shield	II	Provides permanent shielding	Passive Mechanisms	None	Adequate
Shield Bell	II	Provides permanent shielding	Passive Mechanisms	None	Adequate
Shield Valve	II	Provides permanent shielding	Passive Mechanisms	None	Adequate
Hot Cell Viewing Windows	II	Provides permanent shielding	Passive Mechanisms	None	Adequate
Transfer Drawer	II	Design Class Interface. (Provides permanent shielding)	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 6 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	Design Class	Design Class Function			
140/25 ton crane	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Cask Lifting Yoke	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Facility Cask Loading Room Hoist	IIIA	Failure could cause radioactive materials release	Passive Mechanisms	None	Adequate
Facility Grapples	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis

Table 4.8-1, Human Factors Evaluation Requirements of Design Class II/IIIA SSCs Page 7 of 7

Table 4.1-1 Description			Functional Allocation	Human Errors Impacting Safety Function (Excluding Design, Maintenance, and Testing) and Consequence.	Human Factors Screening Results
System/Component	Design Class	Design Class Function			
The Horizontal Emplacement and Retrieval Equipment (HERE)	IIIA	Failure could cause radioactive material release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Hot Cell 15-ton Bridge Crane	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Bridge Mounted Manipulator PAR 6000	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Master-Slave Manipulator	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Overpack Welder Equipment	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Grapple Rotating Block	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis
Canister Shuttle Car	IIIA	Failure could cause radioactive materials release	Active - In use manual	Failure could lead to initiating event for RH Accident Release	To be evaluated during RH analysis